

TOYOTA

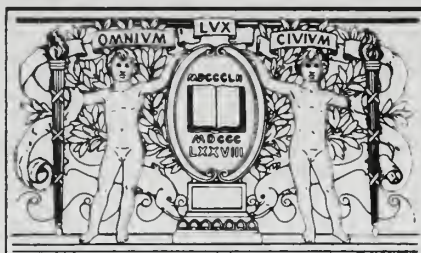
TRUCKS

1989-91 REPAIR MANUAL

**Covers all U.S. and Canadian models of
Toyota Pick-Up, 4Runner and Land Cruiser;
2 and 4 wheel drive**



**COMPLETE WIRING
& VACUUM DIAGRAMS**



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TOYOTA

TRUCKS

1989-91 REPAIR MANUAL

CHILTON

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SAFETY NOTICE

Proper service and repair procedures are vital to the safe, reliable operation of all motor vehicles, as well as the personal safety of those performing repairs. This manual outlines procedures for servicing and repairing vehicles using safe, effective methods. The procedures contain many NOTES, CAUTIONS and WARNINGS which should be followed along with standard safety procedures to eliminate the possibility of personal injury or improper service which could damage the vehicle or compromise its safety.

It is important to note that the repair procedures and techniques, tools and parts for servicing motor vehicles, as well as the skill and experience of the individual performing the work vary widely. It is not possible to anticipate all of the conceivable ways or conditions under which vehicles may be serviced, or to provide cautions as to all of the possible hazards that may result. Standard and accepted safety precautions and equipment should be used when handling toxic or flammable fluids, and safety goggles or other protection should be used during cutting, grinding, chiseling, prying, or any other process that can cause material removal or projectiles.

Some procedures require the use of tools specially designed for a specific purpose. Before substituting another tool or procedure, you must be completely satisfied that neither your personal safety, nor the performance of the vehicle will be endangered.

Although information in this manual is based on industry sources and is complete as possible at the time of publication, the possibility exists that some car manufacturers made later changes which could not be included here. While striving for total accuracy, Chilton Book Company cannot assume responsibility for any errors, changes or omissions that may occur in the compilation of this data.

PART NUMBERS

Part numbers listed in this reference are not recommendations by Chilton for any product by brand name. They are references that can be used with interchange manuals and aftermarket supplier catalogs to locate each brand supplier's discrete part number.

SPECIAL TOOLS

Special tools are recommended by the vehicle manufacturer to perform their specific job. Use has been kept to a minimum, but where absolutely necessary, they are referred to in the text by the part number of the tool manufacturer. These tools can be purchased under the appropriate part number, from Toyota dealer or regional distributor or an equivalent tool can be purchased locally from a tool supplier or parts outlet. Before substituting any tool for the recommended one, read the SAFETY NOTICE at the top of this page.

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1 GENERAL INFORMATION AND MAINTENANCE

HOW TO USE THIS BOOK

Chilton's Total Car Care Manual for Toyota Truck, 4Runner and Land Cruisers is intended to teach you about the inner workings of your truck and save you money on its upkeep.

The first two sections will be the most used, since they contain maintenance and tune-up information and procedures. Studies have shown that a properly tuned and maintained truck can get at least 10% better gas mileage (which translates into lower operating costs) and periodic maintenance will catch minor problems before they turn into major repair bills. The other chapters deal with the more complex systems of your truck.

Operating systems from engine through brakes are covered. It will give you detailed instructions to help you change your own brake pads and shoes, tune-up the engine, replace spark plugs and filters, and do many more jobs that will save you money, give you personal satisfaction and help you avoid expensive problems.

A secondary purpose of this book is a reference guide for owners who want to understand their truck and/or their mechanics better. In this case, no tools at all are required. Knowing just what a particular repair job requires in parts and labor time will allow you to evaluate whether you're getting a fair price quote and help decipher itemized bills from a repair shop.

Before attempting any repairs or service on your truck, read through the entire procedure outlined in the appropriate section. This will give you the overall view of what tools and supplies will be required. There is nothing more frustrating than having to walk to the bus stop on Monday morning because you were short one gasket on Sunday afternoon. So read ahead and plan ahead. Each operation should be approached logically and all procedures thoroughly understood before attempting any work. Some special tools that may be required can often be rented from local automotive jobbers or places specializing in renting tools and equipment. Check the yellow pages of your phone book.

All sections contain adjustments, maintenance, removal and installation procedures, and overhaul procedures. When overhaul is not considered practical, we tell you how to remove the failed part and then how to install the new or rebuilt replacement. In this way, you at least save the labor costs. Backyard overhaul of some components (such as the alternator or water pump) is not practical, but the removal and installation procedure is often simple and well within the capabilities of the average truck owner.

Many procedures in this book require you to "label and disconnect..." a group of lines, hoses or wires. Don't be lulled into thinking you can remember where everything goes—you won't. If you hook up vacuum or fuel lines incorrectly, the car will run poorly, if at all. If you hook up electrical wiring incorrectly, you may instantly learn a very expensive lesson.

You don't need to know the official or engineering name for each hose or line. A piece of masking tape on the hose and a piece on its fitting will allow you assign your own label such as the letter A or a short name. As long as you remember your own code, the lines can be reconnected by matching similar letters or names. Do remember that tape will dissolve in gasoline or other fluids; if a component is to be washed or cleaned, use another method of identification. A permanent felt tip marker can be very handy for marking metal parts. Remove any tape or paper labels after assembly.

It's necessary to mention the difference between maintenance and repair. Maintenance includes routine inspections, adjustments, and replacement of parts which show signs of normal wear. Maintenance compensates for wear or deterioration. Repair implies that something has broken or is not working. Need for repair is often caused by lack of maintenance. Example: Draining and refilling the automatic transmission fluid is maintenance recommended by the manufacturer at specific mileage intervals. Failure to do this will ruin the transmission, requiring

very expensive repairs. While no maintenance program can prevent items from breaking or wearing out, a general rule can be stated: **MAINTENANCE IS CHEAPER THAN REPAIR.**

Some basic mechanic's rules should be learned. One, whenever the left side of the car is mentioned, it means the driver's side of the car. Conversely, the right side of the car means the passenger's side of the car. Second, most screws and bolts are removed by turning counterclockwise and tightened by turning clockwise.

Safety is the most important rule. Constantly be aware of the dangers involved in working on a vehicle and take the proper precautions. Think ahead, work slowly, and anticipate problems before they occur. Use jackstands when working under a raised vehicle. Don't smoke or allow an exposed flame to come near the battery or any parts of the fuel system. If you are using a kerosene heater during the winter, always turn it off or put it well away from the car when charging the battery or performing any item that could release liquid gasoline or gasoline vapors. Use the proper tool and use it correctly. Bruised knuckles and skinned fingers aren't a mechanic's standard equipment. See the part of this section Servicing Your Vehicle Safely, and the **SAFETY NOTICE** on the acknowledgment page before attempting any service procedures. Pay attention to the instructions provided.

There are 3 common mistakes in mechanical work:

1. **Incorrect order of assembly, disassembly or adjustment.** When taking something apart or putting it together, doing things in the wrong order usually costs extra time—however, it CAN break something. Read the entire procedure before beginning disassembly. Do everything in the order in which the instructions say you should do it, even if you can't immediately see a reason for it. When you're taking apart something that is very intricate (for example a carburetor), you might want to draw a picture of how it looks when assembled at one point in order to make sure you get everything back in its proper position. We will supply exploded views whenever possible, but sometimes the job requires more attention to detail than an illustration provides. When making adjustments (especially tune-up adjustments), do them in order. One adjustment often affects another and you cannot expect satisfactory results unless each adjustment is made only when it cannot be changed by any other.

2. **Overtightening (or undertightening) nuts and bolts.** While it is more common for overtightening to cause damage, undertightening can cause a fastener to vibrate loose and cause serious damage, especially when dealing with aluminum parts. Pay attention to torque specifications and use a torque wrench in assembly. If a torque figure is not available, remember that if you are using the right tool to do the job, you will probably not have to strain yourself to get a fastener tight enough. The pitch of most threads is so slight that the tension you put on the wrench will be multiplied many times in actual force on what you are tightening.

An example of the importance of torque can be seen in the case of spark plug installation, especially when installing the plug into an aluminum cylinder head. Too little torque can fail to crush the gasket, causing leakage of combustion gases and consequent overheating of the plug and engine parts. Too much torque can damage the threads or distort the plug, which changes the spark gap at the electrode. Since more and more manufacturers are using aluminum in their engine and chassis parts to save weight, a torque wrench should be in any serious do-it-yourselfer's tool box.

There are many commercial chemical products available for ensuring that fasteners won't come loose, even if they are not torqued just right (a very common brand is Loctite®). If you're worried about getting something together tight enough to hold, but loose enough to avoid mechanical damage during assembly,

one of these products might offer substantial insurance. Read the label on the package and make sure the product is compatible with the materials, fluids, etc. involved before choosing one.

3. **Crossthreading.** This occurs when a part such as a bolt is screwed into a nut or casting at the wrong angle and forced, causing the threads to become damaged. Crossthreading is more likely to occur if access is difficult. It helps to clean and lubricate fasteners, and to start threading with the part to be installed going straight in, using your fingers. If you encounter resistance, unscrew the part and start over again at a different angle until it can be inserted and turned several times without much effort.

Keep in mind that many parts, especially spark plugs, use tapered threads so that gentle turning will automatically bring the part you're threading to the proper angle if you don't force it or resist a change in angle. Don't put a wrench on the part until it's been turned in a couple of times by hand. If you suddenly encounter resistance and the part has not seated fully, don't force it. Pull it back out and make sure it's clean and threading properly.

Always take your time and be patient; once you have some experience, working on your truck will become an enjoyable hobby.

TOOLS AND EQUIPMENT

Naturally, without the proper tools and equipment it is impossible to properly service your vehicle. It would be impossible to catalog each tool that you would need to perform every operation in this book. It would also be unwise for the amateur to rush out and buy an expensive set of tools and the theory that he may need one or more of them at sometime.

The best approach is to proceed slowly, gathering together a good quality set of those tools that are used most frequently. Don't be misled by the low cost of bargain tools. It is far better to spend a little more for better quality. Forged wrenches, 6- or 12-point sockets and fine-toothed ratchets are by far preferable to their less expensive counterparts. As any good mechanic can tell you, there are few worse experiences than trying to work on a truck with bad tools. Your monetary savings will be far outweighed by frustration and mangled knuckles.

Certain tools, plus a basic ability to handle tools, are required to get started. A basic mechanics' tool set, a torque wrench, a Torx® bits set. Torx® bits are hexlobular drivers which fit both inside and outside on special Torx® head fasteners used in various places on some trucks.

Begin accumulating those tools that are used most frequently; those associated with routine maintenance and tune-up.

In addition to the normal assortment of screwdrivers and pliers you should have the following tools for routine maintenance jobs. Virtually every fastener on your truck is metric, although dealer and aftermarket equipment may use SAE (US) hardware.

1. SAE and Metric wrenches, sockets and combination (open end/box end) wrenches in sizes from 1/8 in. (3mm) to 3/4 in. (19mm), and a spark plug socket (13/16 in. or 5/8 in.). If possible, buy various length socket drive extensions. One break in this department is that the metric sockets available in the U.S. will all fit the ratchet handles and extensions you may already have (1/4 in., 3/8 in., and 1/2 in. drive).

Many retail stores run periodic sales on starter sets of wrenches. Although a starter set may not contain every piece you want or need, once the basic set is purchased, specific items may be purchased individually.

2. Jackstands for supporting the truck.
3. Oil filter wrench.
4. Oil filler spout or funnel.
5. Grease gun for chassis lubrication.

6. Hydrometer for checking the battery.

7. A low flat pan for draining oil.

8. Lots of rags for wiping up the inevitable mess.

In addition to the above items there are several others that are not absolutely necessary, but handy to have around. These include oil-dry, a transmission fluid funnel and the usual supply of lubricants, antifreeze and fluids, although these can be purchased as needed. This is a basic list for routine maintenance, but only your personal needs and desires can accurately determine your list of necessary tools.

After performing a few projects on the car, you'll be amazed at the other tools and non-tools on your workbench. Some useful household items to have around are: a large turkey baster or siphon, empty coffee cans and ice trays (storing parts), ball of twine, electrical tape for wiring, small rolls of colored tape for tagging lines or hoses, markers and pens, a note pad, golf tees (for plugging vacuum lines), metal coat hangers or a roll of mechanics's wire (holding things out of the way), whisk broom, dental pick or similar long, pointed probe, a strong magnet, and a small mirror (for seeing into recesses and under manifolds).

The second list of tools is for tune-ups. While the tools involved here are slightly more sophisticated, they need not be outrageously expensive. There are several inexpensive tach/dwell meters on the market that are every bit as good for the average mechanic as a \$300.00 professional model. Just be sure that it goes to at least 1200-1500 rpm on the tach scale and that it works on 4-, 6- and 8-cylinder engines — if you're going to spend the money, get one that will work on anything. A basic list of tune-up equipment could include:

1. Tach-dwell meter

2. Spark plug wrench

3. Timing light (a DC light that works from the truck's battery is best, although an AC light that plugs into 110V house current will suffice at some sacrifice in brightness). Almost all the timing lights available now come with inductive pickups — make sure your's does. This neat little time saver allows the probe to be clipped over the spark plug wire rather than having to disconnect a spark plug wire. Work smarter, not harder.

4. Wire spark plug gauge/adjusting tools

5. Set of feeler blades.

In addition to these basic tools, there are several other tools and gauges you may find useful. These include:

1 GENERAL INFORMATION AND MAINTENANCE

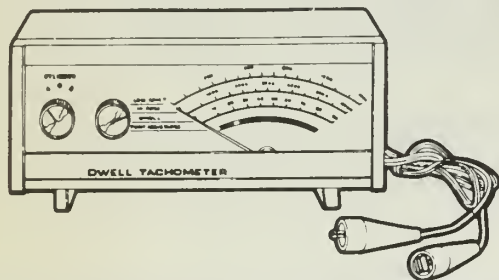
1. A compression gauge. The screw-in type is slower to use, but eliminates the possibility of a faulty reading due to escaping pressure. The press-in type is quicker but may be less accurate. Additionally, the press-type may not be usable on certain engines with deeply recessed spark plug holes.

2. A manifold vacuum gauge.

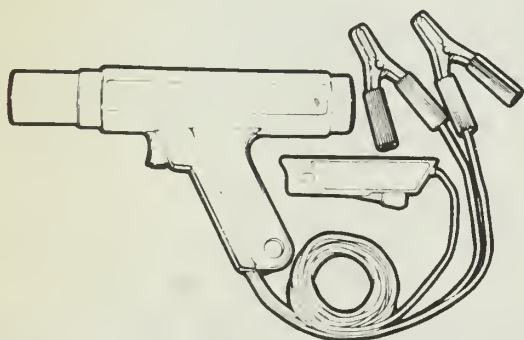
3. A test light.

4. An induction meter. This is used for determining whether or not there is current in a wire. These are handy for use if a wire is broken somewhere in a wiring harness.

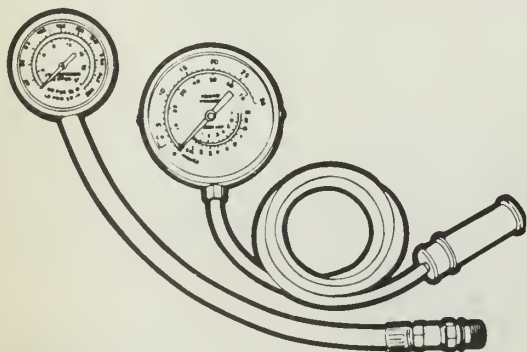
5. In this age of electronics, almost any diagnosis will require either a voltmeter or an ohmmeter. Happily, these tools are often combined into a volt-ohmmeter or VOM. The analog or sweep-needle type is adequate for most diagnostic work. If any



A good dwell-tach is always useful. Vehicles with solid-state ignitions don't require the dwell meter



Don't cut corners on the purchase of a timing light; it should have a metal case and well insulated wires



A compression gauge and a vacuum gauge are both essential for any diagnosis of engine operating problems

work is to be done on solid-equipment or circuits, a high-impedance digital volt-ohmmeter (DVOM) is required. Small analog meters can be found for well under \$50.00, although a larger one is easier to read and may have more scales and functions. DVOM's are more costly, but can be used in much wider applications.

As a final note, you will probably find a torque wrench necessary for all but the most basic work. The beam type models are perfectly adequate, although the newer click (breakaway) type are more precise and you don't have to crane your neck to see a torque reading in awkward situations. The breakaway torque wrenches are more expensive and should be recalibrated periodically.

A good torque wrench will be fairly expensive. Once purchased, treat it with care. It's accuracy can be altered by dropping it, prying with it or subjecting it to other workshop torture. Keep it out of the way until needed. Don't use the torque wrench for non-torquing applications; use a regular ratchet.

Torque specification for each fastener will be given in the procedure in any case that a specific torque value is required. If no torque specifications are given, use the following values as a guide, based upon fastener size:

Bolts marked 6T

6mm bolt/nut—5-7 ft. lbs.

8mm bolt/nut—12-17 ft. lbs.

10mm bolt/nut—23-34 ft. lbs.

12mm bolt/nut—41-59 ft. lbs.

14mm bolt/nut—56-76 ft. lbs.

Bolts marked 8T

6mm bolt/nut—6-9 ft. lbs.

8mm bolt/nut—13-20 ft. lbs.

10mm bolt/nut—27-40 ft. lbs.

12mm bolt/nut—46-69 ft. lbs.

14mm bolt/nut—75-101 ft. lbs.

Special Tools

NOTE: Special tools are occasionally necessary to perform a specific job or are recommended to make a job easier. Their use has been kept to a minimum. When a special tool is indicated, it will be referred to by manufacturer's part number. Where possible, an illustration of the tool will be provided so that an equivalent tool may be used.

Normally, the use of special factory tools is avoided for repair procedures, since these are not readily available for the do-it-yourselfer. When it is possible to perform the job with more commonly available tools, it will be pointed out, but occasionally, a special tool was designed to perform a specific function and should be used. Before substituting another tool, you should be convinced that neither your safety nor the performance of the vehicle will be compromised.

As you read the repair procedures, also look at the illustrations. You may be able to figure out that factory special tool 0000-XYZ is nothing more than a simple bearing puller. Assuming that you can find one of the correct size and installation type, you may use an equivalent tool of another manufacture. Note the key word equivalent—it means equal in every function. Use of an incorrect tool may cause severe damage or injury.

Some special tools are available commercially from major tool manufacturers. Others for your Toyota can be purchased through your Toyota dealer; most factory tools are assigned a part number and may be ordered through normal parts channels. Additionally, tools may be ordered from Owatonna Tool Co., Owatonna, Minnesota 55060.

SERVICING YOUR VEHICLE SAFELY

It is virtually impossible to anticipate all of the hazards involved with automotive maintenance and service but care and common sense will prevent most accidents.

The rules of safety for mechanics range from "don't smoke around gasoline," to "use the proper tool for the job." The trick to avoiding injuries is to develop safe work habits and take every possible precaution.

Do's

- Do keep a class B-C (dry powder) fire extinguisher within arm's reach and know how to use it. Keep a first aid kit in the work area.

- Do wear safety glasses, goggles or a full face shield when cutting, drilling, grinding or prying. If you wear glasses for the sake of vision, then they should be made of hardened glass that can serve also as safety glasses, or wear safety goggles over your regular glasses.

- Do shield your eyes whenever you work around the battery. Batteries contain sulfuric acid. In case of contact with the eyes or skin, flush the area with water or a mixture of water and baking soda and get medical attention immediately.

- Do work neatly. A few minutes spent clearing a workbench or setting up a small table for tools is well worth the effort. Make yourself put tools back on the table when not in use; doing so means you won't have to grope around on the floor for that wrench you need right now. Protect your car while working on it with fender covers. If you don't wish to buy a fender cover, an old blanket makes a usable substitute.

- Do follow manufacturer's directions whenever working with potentially hazardous materials. Both brake fluid and antifreeze are poisonous if taken internally. Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage. If a housepet drinks any amount of coolant, it is a "drop everything" emergency—seek immediate veterinary care.

- Do use safety stands for any under-truck service. Jacks are for raising vehicles; safety stands are for making sure the vehicle stays raised until you want it to come down. Whenever the vehicle is raised, block the wheels remaining on the ground and set the parking brake.

- Do disconnect the negative battery cable when working on the electrical system.

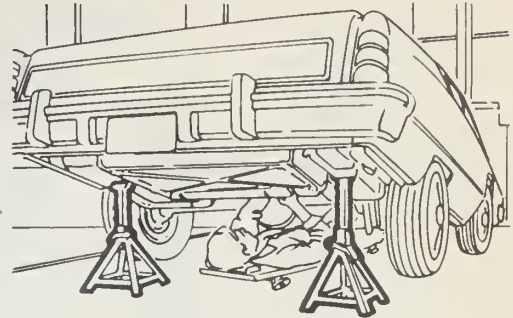
- Do follow manufacturer's directions whenever working with potentially hazardous materials. Both brake fluid and antifreeze are poisonous if taken internally. Never use a soda can or similar container to store drained fluids or bleed brakes; sooner or later somebody will grab it for a drink. Sounds silly, but really happens.

- Do properly maintain your tools. Loose hammerheads, mushroomed punches and chisels, frayed or poorly grounded electrical cords, excessively worn screwdrivers, spread wrenches (open end), cracked sockets, slipping ratchets, or faulty drop-light sockets can cause accidents.

- Do use the proper size and type of tool for the job being done.

- Do, when possible, pull on a wrench handle rather than push on it, and adjust your stance to prevent a fall.

- Do be sure that adjustable wrenches are tightly adjusted on the nut or bolt and pulled so that the face is on the side of the fixed jaw.



Always use jackstands to support any vehicle

- Do select a wrench or socket that fits the nut or bolt. The wrench or socket should sit straight, not cocked. Even though certain metric and SAE sizes are close, they are not the same.
- Do strike squarely with a hammer. Avoid glancing blows.
- Do set the parking brake and block the wheels if the work requires that the engine be running.

Don'ts

- Don't run an engine in a garage or anywhere else without proper ventilation—EVER! Carbon monoxide is odorless and colorless. Your senses cannot detect its presence. Early symptoms of monoxide poisoning include headache, irritability, improper vision (blurred or hard to focus) and/or drowsiness. When you notice any of these symptoms in yourself or your helpers, stop working immediately and get to fresh, outside air. Ventilate the work area thoroughly before returning to the car. Always use power vents, windows, fans or open the garage doors.

- Don't work around moving parts while wearing a necktie or other loose clothing. Short sleeves are much safer than long, loose sleeves. Hard-toed shoes with neoprene soles protect your toes and give a better grip on slippery surfaces. Jewelry such as watches, fancy belt buckles, beads, or body adornment of any kind is not safe while working around a truck. Long hair should be hidden under a hat or cap.

- Don't use pockets for toolboxes. A fall or bump can drive a screwdriver deep into your body. Even a wiping cloth hanging from the back pocket can wrap around a spinning shaft or fan.

- Don't smoke when working around gasoline, cleaning solvent or other flammable material.

- Don't smoke when working around the battery. When the battery is being charged, it gives off explosive hydrogen gas.

- Don't use gasoline to wash your hands. There are excellent soaps and hand cleaners available. Gasoline may contain lead, and lead can enter the body through a cut, accumulating in the body until you are very ill. Gasoline also removes all the natural oils from the skin so that bone dry hands will suck up oil and grease.

- Don't service the air conditioning system unless you are equipped with the necessary tools and training. The refrigerant, R-12, is extremely cold and when exposed to the air, will instantly freeze any surface it comes in contact with, including your eyes. Although the refrigerant is normally non-toxic, R-12 becomes a deadly poisonous gas in the presence of an open flame. One good whiff of the vapors from burning refrigerant can be fatal.

1 GENERAL INFORMATION AND MAINTENANCE

IDENTIFICATION

ENGINE IDENTIFICATION CHART

Years	No. of Cylinders	Actual Displacement			Fuel System	Type	Built by	Engine Code
		Cu. In.	CC	Liters ①				
Truck								
1989	L4	144.4	2367	2.4	Carb.	Gas	Toyota	22R
	L4	144.4	2367	2.4	Inj.	Gas	Toyota	22R-E
	V-6	180.5	2958	3.0	Inj.	Gas	Toyota	3VZ-E
1990	L4	144.4	2367	2.4	Carb.	Gas	Toyota	22R
	L4	144.4	2367	2.4	Inj.	Gas	Toyota	22R-E
	V-6	180.5	2958	3.0	Inj.	Gas	Toyota	3VZ-E
1991	4	144.4	2367	2.4	Inj.	Gas	Toyota	22R-E
	V-6	180.5	2959	3.0	Inj.	Gas	Toyota	3VZ-E
Land Cruiser								
1989	L6	241.3	3955	4.0	Inj.	Gas	Toyota	3F-E
1990	L6	241.4	3956	4.0	Inj.	Gas	Toyota	3F-E
1991	L6	241.4	3956	4.0	Inj.	Gas	Toyota	3F-E
4-Runner								
1989-90	L4	144.4	2367	2.4	Inj.	Gas	Toyota	22R-E
	V-6	180.5	2959	3.0	Inj.	Gas	Toyota	3VZ-E
1991	L4	144.4	2367	2.4	Inj.	Gas	Toyota	22R-E
	V-6	180.5	2959	3.0	Inj.	Gas	Toyota	3VZ-E

① Nominal (common) designation

MANUAL TRANSMISSION APPLICATION CHART

Transmission Types	Years	Models
G40	1989-90	Truck
G57	1989-91	Truck
G58	1989-91	4WD Truck, 4-Runner 4WD
W46	1989-90	Truck
W55	1989-91	Truck
W56	1989-91	4WD Truck, 4-Runner 2&4WD
R150	1989-91	Truck
R150F	1989-91	4WD Truck, 4-Runner 4WD

AUTOMATIC TRANSMISSION APPLICATION CHART

Transmission	Years	Models
A 43D—4 sp	1989-91	2WD Truck w/22R-E
A 340E—4 sp ECT ①	1989-91	2WD Truck w/3VZ-E
A 340 H—4 sp ECT ②	1989-91	4WD Truck w/3VZ-E
A 340 F—4 sp ③	1989-91	4WD Truck w/22R-E

AUTOMATIC TRANSMISSION APPLICATION CHART

Transmission	Years	Models
A 440 F—4 sp ^①	1989-91	Land Cruiser
A 44D—4 sp	1989-91	2WD 4-Runner w/23R-E
A 340 E—4 sp ECT	1989-91	2WD 4-Runner w/3VZ-E
A 340 H—4 sp ECT ^②	1989-91	4WD 4-Runner w/3VZ-E
A 340 F—4 sp ^③	1991	4WD 4-Runner w/3VZ-E

① Electronically controlled transmission

② With electronically controlled transfer case

③ With mechanically controlled transfer case

TRANSFER CASE APPLICATION CHART

Transfer Case Types	Years	Models
VF1A (Planetary Gear)	1991	4-Runner with 3VZ-E/R150F
	1989-90	Truck & 4-Runner: 3VZ-E/R150F
	1991	Truck: or 22R-E/G58
	1990-91	Truck with 22R-E/A340F
RF1A (Counter Gear)	1991	4-Runner with 22R-E/w56
	1989-91	Truck & 4-Runner with 22RE/w56
Integral	1989-90	Land Cruiser with 3FE/A440F
HF2A	1991	Land Cruiser with 3FE/A440F

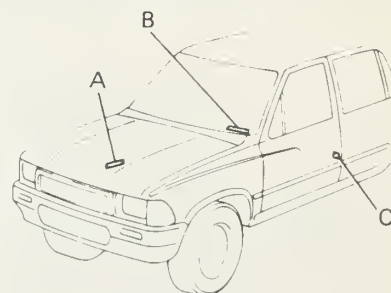
Vehicle Identification Number

All 1989-91 models have the vehicle identification number stamped on a plate attached to the left side of the instrument panel. The plate is visible by looking through the windshield from the outside.

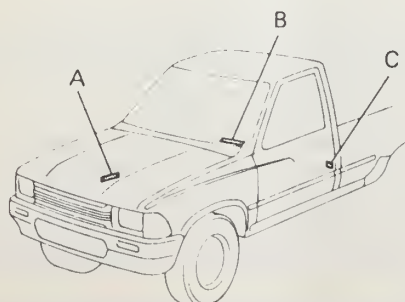
Trucks and 4Runners also have the VIN stamped into the metal of the outer face of the right front frame rail. The number also appears on the Certification label attached to the left door pillar.

In addition to the instrument panel number, all Land Cruisers display the VIN on the Certification Label on the left front door post. 1991 Land Cruisers also have the number stamped into the outer face of the right front frame rail.

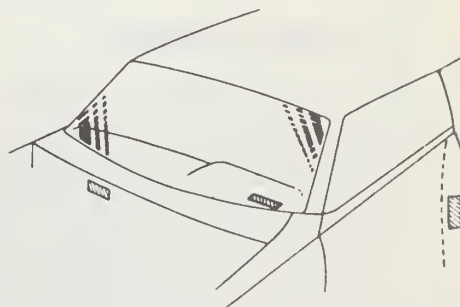
The serial number on all 1989-91 models consists of a series of 17 digits including the six digit serial or production number. The first three digits are the World Manufacturer Identification



Vehicle number locations — 4Runner

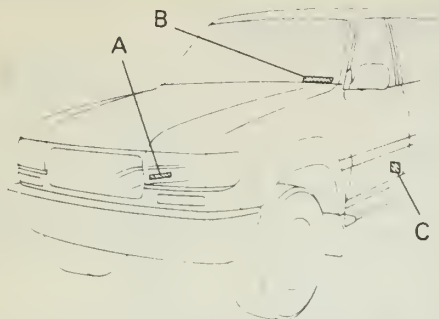


VIN locations — Trucks



VIN locations — 1989 and 1990 Land Cruisers

1 GENERAL INFORMATION AND MAINTENANCE



Location of vehicle Identification numbers — 1991 Land Cruiser

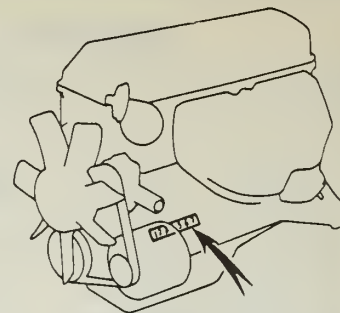
number. The next five digits are the Vehicle Description Section. The remaining nine digits are the production numbers including various codes on body style, trim level (base, luxury, etc.) and safety equipment or other information.

Engine Identification Numbers

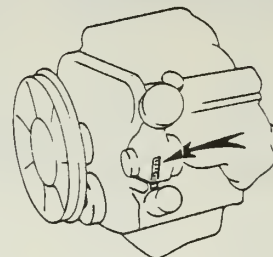
Each engine is referred to by both its family designation, such as 22R-E, and its production or serial number. The serial number can be important when ordering parts. Certain changes may have been made during production of the engine; different parts will be required if the engine was assembled before or after the change date. Generally, parts stores and dealers list this data in their catalogs, so have the engine number handy when you go.

The 4-cylinder 22R and 22R-E engines as well as the V-6 3VZ-E engine have the engine number stamped into the front left side of the engine block, just behind the alternator. The straight 6-cylinder 3F-E used in the Land Cruiser has the number stamped on the right side of the block at the rear.

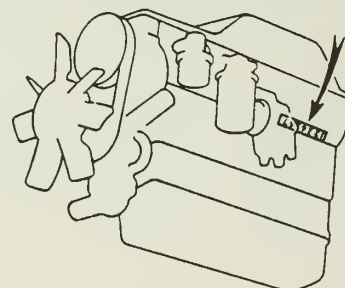
It's a good idea to record the engine number while the vehicle is new. Jotting it inside the cover of the owner's manual or similar easy-to-find location will prevent having to scrape many years of grime off the engine when the number is finally needed.



Engine number location — 22R and 22R-E engines



Engine number location — 3VZ-E engine



Engine number location — 3F-E engine

ROUTINE MAINTENANCE

Air Filter Element

REMOVAL AND INSTALLATION

The air filter element should be replaced at the recommended intervals shown in the Maintenance Intervals chart later in this Section. If your truck is operated under severely dusty conditions or severe operating conditions, more frequent changes will certainly be necessary. Inspect the element at least twice a year. Early spring and early fall are always good times for inspection. Remove the element and check for any perforations or tears in the filter. Check the cleaner housing for signs of dirt or dust that may have leaked through the filter element or in through

the snorkel tube. Shine a bright light on one side of the element and look through the filter at the light. If no glow of light can be seen through the element material, replace the filter. If holes in the filter element are apparent or signs of dirt seepage through the filter are evident, replace the filter.

1. Disconnect all hoses, ducts and vacuum tubes which would block removal of the top of the air cleaner assembly.

2. For round air cleaner housings, remove the top cover wing nut and grommet, if present. Most models will also use three or four side clips to further secure the top of the assembly. Pull the wire tab and release the clip. Remove the cover and lift out the filter element.

3. On fuel injected engines, simply release the clips holding the top of the air box and lift the lid. Note that some of these

clips may be in close quarters against bodywork or other components; don't pry or force the clips.

4. Remove the filter element. Clean or replace as needed. Wipe clean all surfaces of the air cleaner housing and cover. Check the condition of the mounting gasket and replace it if it appears worn or broken.

5. Reposition the filter element in the case and install the cover, being careful not to overtighten the wingnut(s). On round-style cleaners (carbureted engines), be certain that the arrows on the cover lid and the snorkel match up properly. The lid of the air cleaner housing must be correctly installed and fit snugly. Air leaks around the top can cause air to bypass the filter and allow dirt into the engine.

NOTE: Filter elements on fuel injected engines have a TOP and BOTTOM side, be sure they are inserted correctly.

7. Connect all hoses, ductwork and vacuum lines.

NOTE: Never operate the engine without the air filter element in place.

Fuel Filter

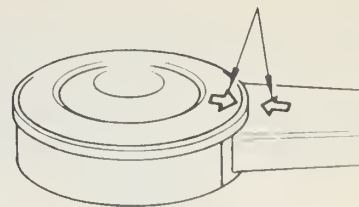
REMOVAL AND INSTALLATION

CAUTION

Never smoke when working around or near gasoline. Make sure that there are no active ignition sources (heaters, electric motors or fans, welders, anything with sparks or open flame.) in the area. Have a fire extinguisher within arm's reach at all times.

3F-E Engine

1. Unbolt the retaining screws and remove the protective shield from the fuel filter.
2. Place a pan under the delivery pipe to catch the dripping



Arrows must be aligned when installing the 22R air cleaner cover

fuel and SLOWLY loosen the union bolt to bleed off the fuel pressure. The fuel system is under pressure. Release pressure slowly and contain spillage. Observe no smoking/no open flame precautions.

3. Remove the union bolt and drain the remaining fuel.
4. Disconnect and plug the inlet line.
5. Unbolt and remove the fuel filter.

NOTE: When tightening the fuel line bolts to the fuel filter, you must use a torque wrench. The tightening torque is very important, as under or over tightening may cause fuel leakage. Insure that there is no fuel line interference and that there is sufficient space between the fuel lines and other components.

6. Coat the flare unit, union nut and all bolt threads with engine oil.

7. Hand tighten the inlet line to the fuel filter.

8. Install the fuel filter and then tighten the inlet line nut to 22 ft. lbs. (29 Nm).

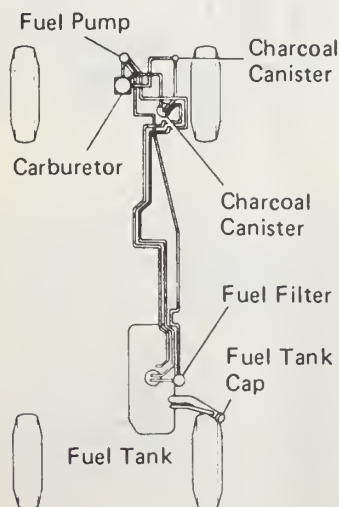
9. Reconnect the delivery pipe using new gaskets and then tighten the union bolt to 22 ft. lbs. (29 Nm).

10. Run the engine for a short period and check for any fuel leaks.

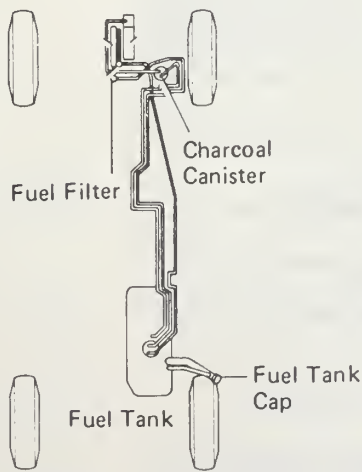
11. Install the protective shield.

Additionally, Land Cruisers require the replacement of the

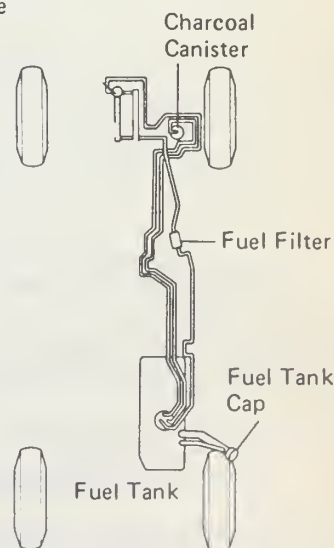
22R Engine



22R-E Engine



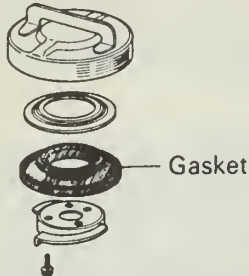
3VZ-E Engine



Fuel filter locations, truck and 4Runner

1 GENERAL INFORMATION AND MAINTENANCE

fuel filler cap gasket at 60,000 miles. The gasket is important in sealing the filler neck and keeping the vapors from the tank routed through the vapor emission system. 1989 vehicles hold the gasket with 4 small screws and a retaining plate which must be removed. Later models eliminate the screws and retainer; gently pry the gasket off with your fingers. Install the new gasket and make certain it is not twisted or crimped.



Replacing the fuel filler cap gasket. Newer models don't use the 4 screws and retainer

22R Engines

1. Using a pair of pliers, expand the hose clamp on one side of the filter, and slide the clamp further down the hose, past the point to which the filter pipe extends. Remove the other clamp in the same manner.

2. Grasp the hoses near the ends and twist them gently to pull them free from the filter pipes.

3. Pull the filter from the clip and discard.

4. Install the new filter into the clip. The arrow must point towards the hose that runs to the carburetor. Push the hoses onto the filter pipes, and slide the clamps back into position. Start the engine and check for leaks.

22R-E, 3VZ-E Engines

1. Unbolt the retaining screws and remove the protective shield from the fuel filter.

2. Place a pan under the delivery pipe (large connection) to catch the dripping fuel and SLOWLY loosen the union bolt to bleed off the fuel pressure.

3. Remove the union bolt and drain the remaining fuel.

4. Disconnect and plug the inlet line.

5. Unbolt and remove the fuel filter.

NOTE: When tightening the fuel line bolts to the fuel filter, you must use a torque wrench. The tightening torque is very important, as under or over tightening may cause fuel leakage. Insure that there is not fuel line interference and that there is sufficient clearance between it and any other components.

6. Coat the flare unit, union nut and all bolt threads with engine oil.

7. Hand tighten the inlet line to the fuel filter.

8. Install the fuel filter and then tighten the inlet line nut to 22 ft. lbs. (29 Nm).

9. Reconnect the delivery pipe using new gaskets and then tighten the union bolt to 22 ft. lbs. (29 Nm).

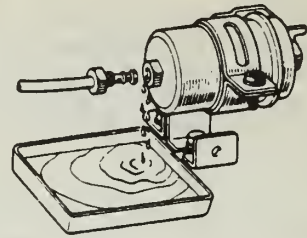
10. Run the engine for a few minutes and check for any fuel leaks.

11. Install the protective shield.

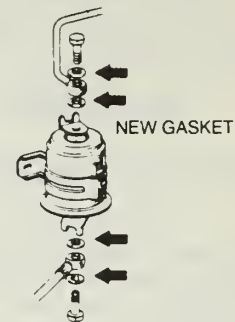
PCV Valve

The PCV valve regulates crankcase ventilation during various engine operating conditions. At high vacuum (idle speed and partial load range) it will open slightly and at low vacuum (full throttle) it will open fully. This causes vapor to be removed from the crankcase by the engine vacuum and then sucked into the combustion chamber where it is burned along with the fuel..

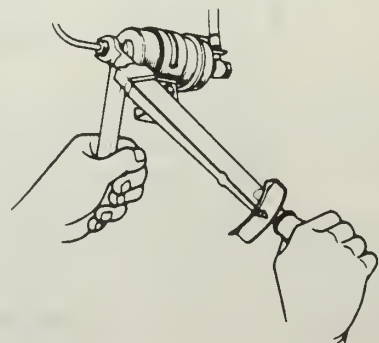
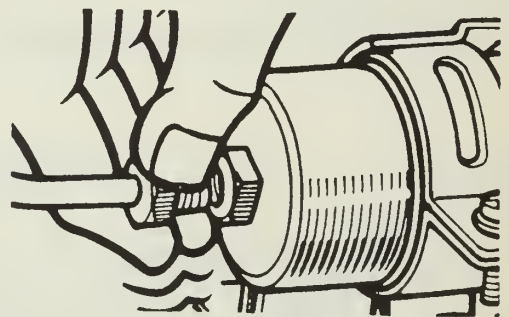
NOTE: The PCV system will not function properly unless the oil filler cap is tightly sealed. Check the gasket on the cap and be certain it is not leaking. Replace the cap or gasket or both if necessary to ensure proper sealing.



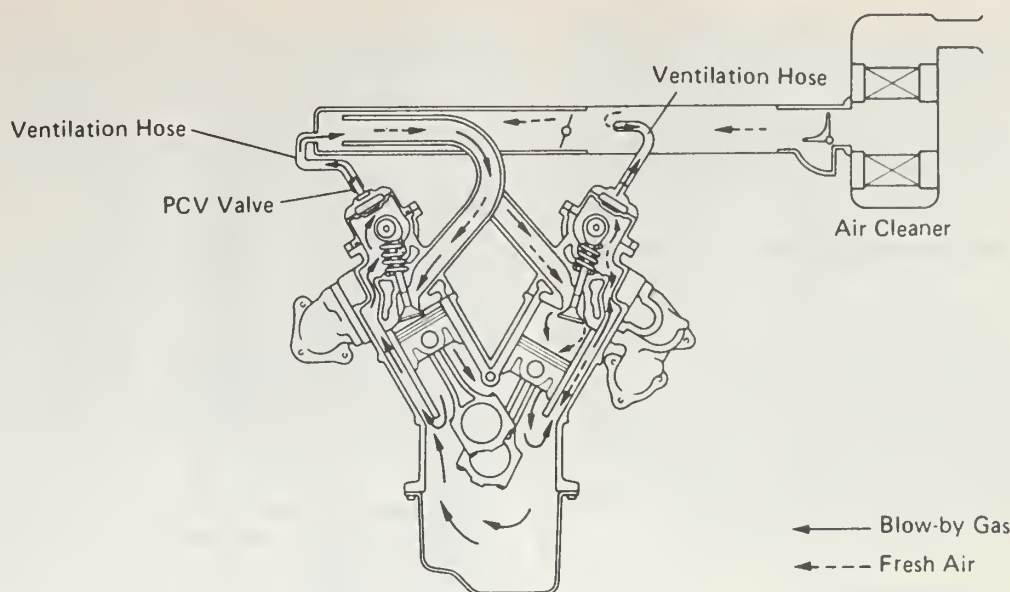
Always collect spilled fuel during filter changes



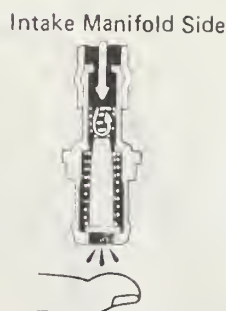
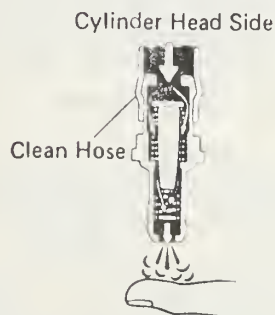
New gaskets must be used any time the banjo fitting is loosened or disassembled



During installation, hand tighten the fuel lines first, then final tighten with a torque wrench



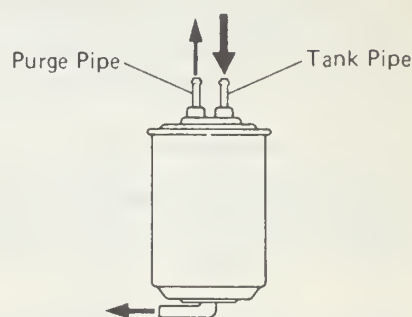
PCV valve and vapor circulation of 3VZ-E engine



Use a clean hose to test air flow of the PCV. Never place the valve in your mouth

REMOVAL AND INSTALLATION

1. Check the ventilation hoses and lines for leaks or clogging. Clean or replace as necessary.
2. Locate the PCV valve in the cylinder head cover and remove it by pulling it upward.
3. Attach a clean tube to the crankcase end of the valve and blow through it. There should be free passage of air through the valve.
4. Move the tube to the other end of the valve. Blow into the tube. There should be little or no passage of air through the valve.
5. If the PCV valve failed either of the preceding two checks, it will require replacement.



Inspecting the charcoal canister

6. To install, simply slip the hose back onto the proper end of the PCV valve and then press it into the retaining grommet in the cylinder head cover.

Evaporative Emission Control Canister (Charcoal Canister)

The canister cycles the fuel vapor from the fuel tank and, if carbureted, the carburetor float chambers into the intake manifold and eventually into the cylinders for combustion. The activated charcoal element within the canister acts as a storage device for the fuel vapors at times when the engine operating conditions do not allow efficient burning of the vapors.

1 GENERAL INFORMATION AND MAINTENANCE

The only required service for the canister is inspection at the intervals specified in the Maintenance Chart at the end of this Section. If the charcoal element is saturated (possibly from carburetor flooding), the entire canister will require replacement. Label and disconnect the canister purge hoses, loosen the retaining bracket bolt(s) and lift out the canister. Installation is simply the reverse of the removal process. To check the canister:

1. Remove the canister. Inspect the case for any cracking or damage.
2. Using low pressure compressed air, blow into the tank pipe (flanged end) and check that air flows freely from the other ports.
3. Blow into the purge pipe (next to tank pipe) and check that air does not flow from the other ports. If air does flow, the check valve has failed and the canister must be replaced.
4. Never attempt to flush the canister with fluid or solvent. Low pressure air (43 psi, max.) may be used to evaporate any vapors within the canister. When applying the air, hold a finger over the purge pipe to force all the air out the bottom port.
5. No carbon should come out of the filter at any time. Loose charcoal is a sign of internal failure in the canister.

Battery

Loose, dirty, or corroded battery terminals are a frequent cause of "no-start" conditions. Every 3 months or so, remove the battery terminals and clean them, giving them a light coating of petroleum jelly when you are finished. This will help to retard corrosion.

WARNING: Never disconnect the battery with the engine running or with the ignition turned on. Severe and expensive damage to the on-board computers will result. With the ignition off and the key removed for safety, always disconnect the negative (-) cable first and connect it last.

NOTE: When the battery is disconnected, various solid state accessories on the car may lose their memory. Be prepared to re-program the radio and reset the clock. Some Toyota vehicles with anti-theft radios will require entry of the owner's identification number or the audio system will not work.

Check the battery cables for signs of wear or chafing and replace any cable or terminal that looks marginal. Battery terminals can be easily cleaned; inexpensive cleaning tools are an excellent investment that will pay for themselves many times over. They can usually be purchased from any well-equipped auto store or parts department. The accumulated white powder and corrosion can be cleaned from the top of the battery with an old toothbrush and a solution of baking soda and water.

Unless you have a "maintenance-free" battery, check the electrolyte (fluid) level frequently. Be sure that the vent holes in each cell cap are not blocked by grease or dirt. The vent holes allow hydrogen gas, formed by the chemical reaction in the battery, to escape safely.

Check the battery electrolyte level at least once a month, more often in hot weather or during periods of extended operation. The level should be maintained between the upper and lower levels marked on the battery case, or to the split ring within the well in each cell. If the electrolyte level is low, distilled water should be added until the proper level is reached. Tap water is to be avoided if possible; the minerals it contains can shorten battery life by reacting with the metal plates inside the battery. Each cell is completely separate from the others, so each cell must be filled individually. It's a good idea to add the distilled water with a squeeze bulb to avoid having electrolyte (sulphuric acid) splash out.

NOTE: Cars that are regularly driven at highway speeds over moderate to long distances may require battery service more frequently. Constant charging of the battery will cause some water to evaporate.

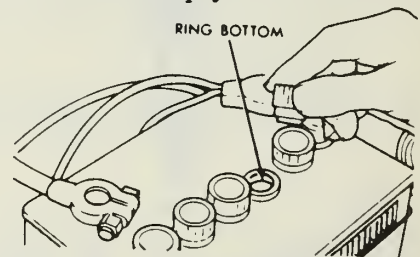
At least once a year check the specific gravity of the battery electrolyte. It should be between 1.22 and 1.28 at room temperature. A reading of 1.00 or slightly above indicates nothing but water within the battery. The electrical.

process has stopped and it's time for a new battery. You cannot successfully add acid to a used battery. If water is added in freezing weather, the vehicle should be driven several miles to allow the water to mix with the electrolyte and prevent freezing.

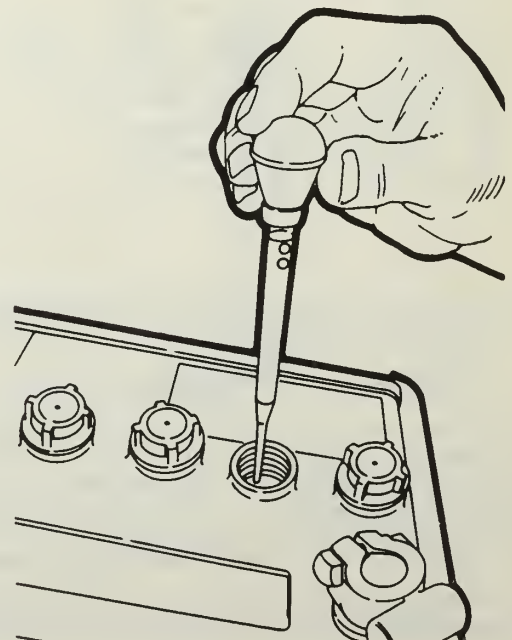
If the battery becomes corroded, or if electrolyte should splash out during additions of water, a mixture of baking soda and water will neutralize the acid. This should be washed off with cold water after making sure that the cell caps are tight. Battery fluid is particularly nasty to painted surfaces; work carefully to avoid spillage on fenders and other painted bodywork.

If a charging is required while the battery is in the car, disconnect the battery cables, negative (ground) cable first. If you have removed the battery from the vehicle for charging, make sure the battery is not sitting on bare earth or concrete while being charged. A block of wood or a small stack of newspapers will prevent the battery from losing internal heat while charging.

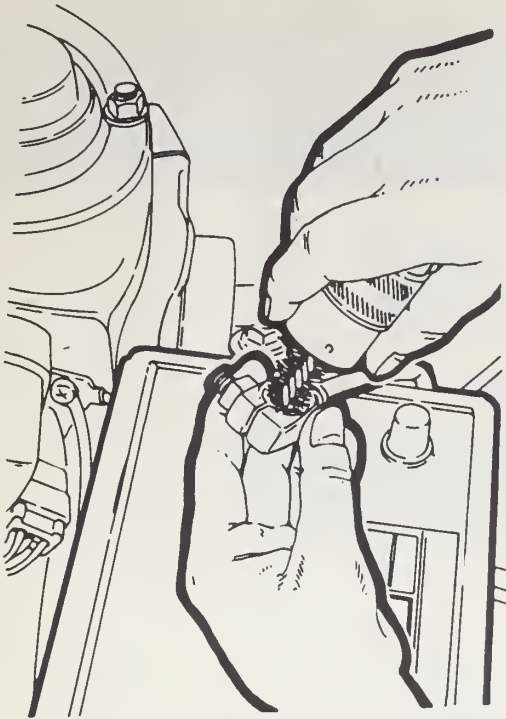
When replacing a battery, it is important that the replacement have an output rating equal to or when greater than original equipment. Do not confuse physical size with electrical



Fill the cells only to the bottom of the ring



Once per year, the specific gravity should be checked



An inexpensive battery terminal tool will clean cables and posts

capacity. A stronger battery (capable of delivering more power) need not be much larger than the original. A physically larger battery may not fit in the truck and may actually deliver less power than the original.

CAUTION

Keep flame or sparks away from the battery; it gives off explosive hydrogen gas. Battery electrolyte contains sulphuric acid. If you should splash any on your skin or in your eyes, flush the affected area with plenty of clear water. If it lands in your eyes, get medical help immediately.

MAINTENANCE-FREE BATTERIES

All Toyota trucks, 4Runners and Land Cruisers come with a low maintenance battery. While this may be billed as maintenance free by some, every battery should have the terminals checked for tightness and cleanliness periodically. The fluid level may be viewed through the side of the case; the plastic is translucent and will show the fluid level. The case has UPPER and LOWER level lines embossed in the plastic; the fluid must be between the lines.

If the fluid is low, the cell cover may be removed. On some batteries, gently prying up the long bar will remove the group of 3 cell covers; on others, removing the bar exposes the individual cell caps which must be unscrewed with a wide coin or screwdriver. Fill the cell(s) only to the UPPER level and replace the caps and covers.

Drive Belts

Check the condition of the drive belts and check the belt tension at least every 15,000 miles (24,000 km).

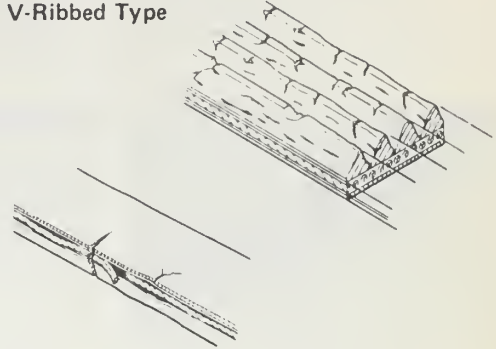
1. Inspect the belts for signs of glazing or cracking. A glazed belt will be perfectly smooth from slippage, while a good belt will have a slight texture of fabric visible. Cracks will generally start at the inner edge of the belt and run outward. Replace the belt at the first sign of cracking or if the glazing is severe.

2. Belt tension does not refer to play or droop. By placing

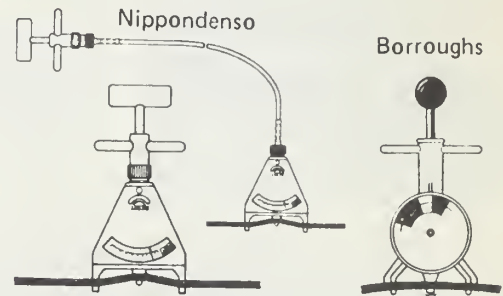
your thumb midway between the two pulleys, it should be possible to depress the belt $\frac{1}{4}$ – $\frac{1}{2}$ in. If any of the belts can be depressed more than this, or cannot be depressed this much, adjust the tension. While this is an inaccurate test, it provides a quick reference. Inadequate tension will always result in slippage or wear, while excessive tension will damage pulley bearings and cause belts to fray and crack. A belt should be just tight enough to perform without slipping or squealing.

3. It's not a bad idea to replace all drive belts at 60,000 miles (96,000 km) regardless of their condition.

V-Ribbed Type



Look for obvious signs of damage on both sides of the belt



Examples of belt tension tools

ADJUSTMENT

Toyota measures belt tension in pounds of force as determined by a belt tension tester. The Nippondenso and Burroughs testers are available through dealers or may be found at retail auto parts stores. The tester slips over a short section of the drive belt, and, when tightened, reads the deflection pressure on a dial. This is one of the most exact ways of setting tension and purchase of this tool or its equivalent is recommended.

Specifications for new belts are slightly higher than for used belts. A new belt is one which has not been run under tension for more than 5 minutes. Anything else is a used belt. All specifications are valid to plus or minus 20 lbs.

22R and 22R-E Engines

- Alternator with air pump: Ribbed belts:
With air conditioning: New, 160; Used, 100
Without air conditioning: New, 105; Used, 85
- Non-ribbed (V) belt: New, 125; Used, 80

3VZ-E Engine

- Alternator: New, 160; Used, 100
- Pwr Steering: New, 125; Used, 80
- Air Conditioning: New, 125; Used, 80

3F-E Engine

- Alternator: New, 145; Used, 100
- Pwr Steering and air pump: New, 145; Used, 100
- Air conditioning: New, 125; Used, 80

1 GENERAL INFORMATION AND MAINTENANCE

HOW TO SPOT WORN V-BELTS

V-Belts are vital to efficient engine operation—they drive the fan, water pump and other accessories. They require little maintenance (occasional tightening) but they will not last forever. Slipping or failure of the V-belt will lead to overheating. If your V-belt looks like any of these, it should be replaced.



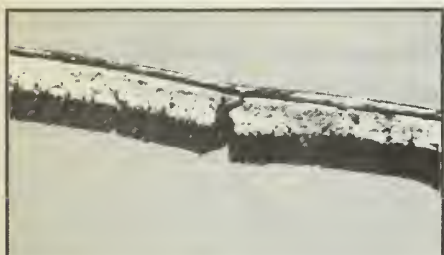
Cracking or Weathering

This belt has deep cracks, which cause it to flex. Too much flexing leads to heat build-up and premature failure. These cracks can be caused by using the belt on a pulley that is too small. Notched belts are available for small diameter pulleys.



Softening (Grease and Oil)

Oil and grease on a belt can cause the belt's rubber compounds to soften and separate from the reinforcing cords that hold the belt together. The belt will first slip, then finally fail altogether.



Glazing

Glazing is caused by a belt that is slipping. A slipping belt can cause a run-down battery, erratic power steering, overheating or poor accessory performance. The more the belt slips, the more glazing will be built up on the surface of the belt. The more the belt is glazed, the more it will slip. If the glazing is light, tighten the belt.



Worn Cover

The cover of this belt is worn off and is peeling away. The reinforcing cords will begin to wear and the belt will shortly break. When the belt cover wears in spots or has a rough jagged appearance, check the pulley grooves for roughness.



Separation

This belt is on the verge of breaking and leaving you stranded. The layers of the belt are separating and the reinforcing cords are exposed. It's just a matter of time before it breaks completely.

REPLACEMENT

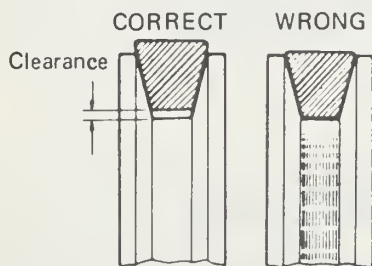
When buying replacement belts, remember that the fit is critical according to the length of the belt ("diameter"), the width of the belt, the depth of the belt and the angle or profile of the V shape. The belt shape should exactly match the shape of the pulley; belts that are not an exact match can cause noise, slippage and premature failure.

If a belt must be replaced, the driven unit must be loosened and moved to its extreme loosest position, generally by moving it toward the center of the motor. After removing the old belt, check the pulleys for dirt or built-up material which could affect belt contact. Carefully install the new belt, remembering that it is new and unused—it may appear to be just a little too small to fit over the pulley flanges.

Fit the belt over the largest pulley (usually the crankshaft pulley at the bottom center of the motor) first, then work on the smaller one(s). Gentle pressure in the direction of rotation is helpful. Some belts run around a third or idler pulley, which acts as an additional pivot in the belt's path. It may be possible to loosen the idler pulley as well as the main component, making your job much easier. Depending on which belt(s) you are changing, it may be necessary to loosen or remove other interfering belts to get at the one(s) you want.

After the new belt is installed, draw tension on it by moving the driven unit away from the motor and tighten its mounting bolts. This is sometimes a three or four-handed job; you may find an assistant helpful. Make sure that all the bolts you loosened get re-tightened and that any other loosened belts also

Conventional



The new belt must fit the pulley correctly



Make sure ribbed belts fit correctly on all pulleys

have the correct tension. A new belt can be expected to stretch a bit after installation so be prepared to re-adjust your new belt, if needed, within the first hundred miles of use.

Hoses

CAUTION

On models equipped with an electric cooling fan, disconnect the negative battery cable, or fan motor wiring harness connector before replacing any radiator/heater hose. The fan may come on, under certain circumstances, even though the ignition is OFF.

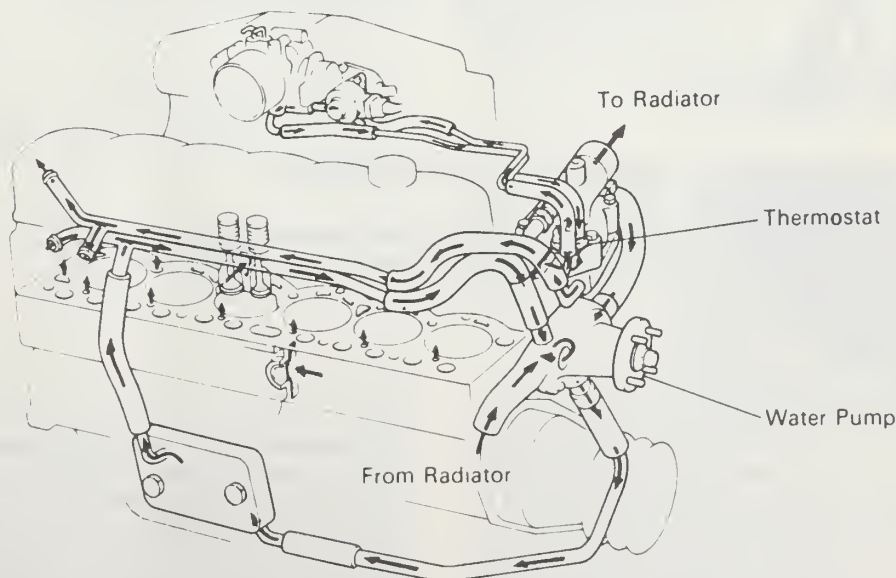
Inspect the condition of the radiator and heater hoses periodically. Early spring and at the beginning of the fall or winter, when you are performing other maintenance, are good times. Make sure the engine and cooling system are cold. Visually inspect for cracking, rotting or collapsed hoses, replace as necessary. Run your hand along the length of the hose. If a weak or swollen spot is noted when squeezing the hose wall, replace the hose.

REPLACEMENT

Replacing hoses requires draining the cooling system. This potentially messy job involves working under the car and handling antifreeze, a slippery, smelly, stain-making chemical. Have a large drain pan or bucket available along with healthy supply of rags. Be prepared to deal with fluid spills immediately. See the previous list of Do's and Don'ts for other hints.

WARNING: Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

1. Drain the cooling system. This is always done with the motor cold. Attempting to drain hot coolant is very foolish; you can



Modern engines use many hoses. Note the coolant paths to the throttle body and the oil cooler on the 3F-E engine

1 GENERAL INFORMATION AND MAINTENANCE

HOW TO SPOT BAD HOSES

Both the upper and lower radiator hoses are called upon to perform difficult jobs in an inhospitable environment. They are subject to nearly 18 psi at under hood temperatures often over 280°F, and must circulate nearly 7500 gallons of coolant an hour—3 good reasons to have good hoses.



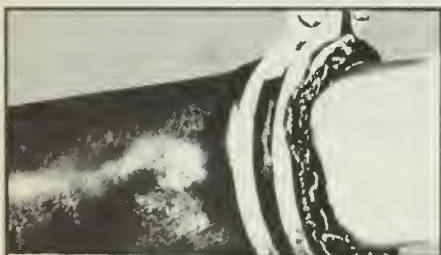
Swollen Hose

A good test for any hose is to feel it for soft or spongy spots. Frequently these will appear as swollen areas of the hose. The most likely cause is oil soaking. This hose could burst at any time, when hot or under pressure.



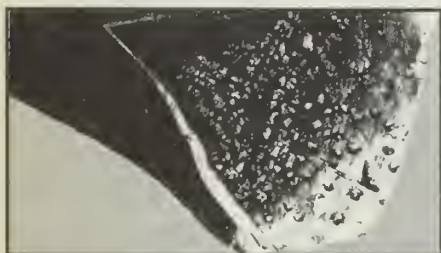
Cracked Hose

Cracked hoses can usually be seen but feel the hoses to be sure they have not hardened; a prime cause of cracking. This hose has cracked down to the reinforcing cords and could split at any of the cracks.



Frayed Hose End (Due to Weak Clamp)

Weakened clamps frequently are the cause of hose and cooling system failure. The connection between the pipe and hose has deteriorated enough to allow coolant to escape when the engine is hot.



Debris In Cooling System

Debris, rust and scale in the cooling system can cause the inside of a hose to weaken. This can usually be felt on the outside of the hose as soft or thinner areas.

be badly scalded. Toyota engines and radiators may be drained by opening the drain cock at the base of the radiator or block drain on the side of the engine block. An alternative method is:

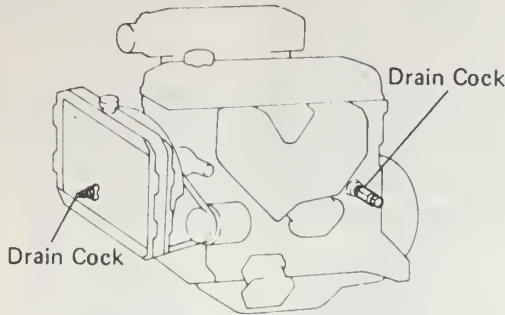
- a. Remove the radiator cap.
- b. Position the drain pan under the point where the lower radiator hose hooks to the radiator. Loosen the clamp on the hose and slide it back so it's out of the way.
- c. Gently break the grip of the hose on its fitting by twisting or prying with a suitable tool. Do not exert too much force

or you will damage the radiator fitting. As the hose loosens, you can expect a gush of fluid to come out—be ready.

- d. Remove the hose end from the radiator and direct the hose into the drain pan. You now have fluid running from both the hose and the radiator. When the system stops draining, proceed with replacement of the damaged hose.

2. Loosen the hose clamps on the damaged hose with a screwdriver and slide the clamps either off the hose altogether or in toward center.

3. Break the grip of the hose at both ends by prying it free with a suitable tool or by twisting it with your hand.
4. Remove the hose.



Location of drain cocks on 22R and 22R-E engines

5. Install a new hose. A small amount of soapy water window cleaner on the inside of the hose end will ease installation.

NOTE: Radiator hoses should be routed with no kinks and, when installed, should be in the same position as the original. If other than specified hose is used, make sure it does not rub against either the engine or the frame while the engine is running, as this may wear a hole in the hose. Contact points may be insulated with a piece of sponge or foam; plastic wire ties are particularly handy for this job.

6. Slide the hose clamps back into position and re-tighten. When tightening the clamps, tighten them enough to seal in the coolant but not so much that the clamp cuts into the hose or causes it internal damage. If a clamp shows signs of any damage (bent, too loose, hard to tighten, etc.) now is the time to replace it. A good rule of thumb is that a new hose is always worth new clamps.

7. Reinstall the lower radiator hose and secure its clamp.

8. Fill the system with coolant. Toyota strongly recommends that the coolant mixture be a 50-50 mix of antifreeze and water. This mixture gives best combination of antifreeze and anti-boil characteristics for year-round driving.

9. Replace and tighten the radiator cap. Start the engine and check visually for leaks. Allow the engine to warm up fully and continue to check your work for signs of leakage. A very small leak may not be noticed until the system develops internal pressure. Leaks at hose ends are generally clamp related and can be cured by snugging the clamp. Larger leaks may require removing the hose again. To do this, you **MUST WAIT UNTIL THE ENGINE HAS COOLED DOWN, GENERALLY A PERIOD OF HOURS. NEVER UNCAP A HOT RADIATOR.** After all leaks are cured, check the coolant level in the radiator (with the engine cold) and top up as necessary.

Air Conditioning System

OPERATION

Refrigerant Cycle

Once the system is fully charged and free of leaks, it is ready to operate on demand. When turned on, the compressor discharges high temperature and high pressure refrigerant. This refrigerant contains heat transferred from inside the car plus the heat developed by the compressor on the discharge stroke.

This gaseous refrigerant flows into the condenser. Because of the airflow through the condenser (either from the motion of the car or the action of the fans), heat is removed from the gas. Now cooled, the gas condenses into a liquid and flows into the receiver/dryer. The receiver/drier stores the liquid refrigerant and filters out small amounts of moisture which may be present.

Flowing from the receiver, the liquid refrigerant passes through an expansion valve which changes it into a low temperature, low pressure mixture of gas and liquid. This cold and foggy refrigerant flows to the evaporator.

Once in the evaporator (inside the cabin of the vehicle) the refrigerant is exposed to the warmer air being moved by the blower fan. The refrigerant changes to a gas within the evaporator and absorbs heat from the air being circulated by the fan. After being fully vaporized within the evaporator, the heated refrigerant gas is drawn out of the evaporator to the compressor where the cycle continues.

NOTE: This book contains simple testing and charging procedures for your truck's air conditioning system. More comprehensive testing, diagnosis and service procedures may be found in **CHILTON'S GUIDE TO AIR CONDITIONING SERVICE AND REPAIR**, book part number 7580, available at your local retailer.

SAFETY

There are two particular hazards associated with air conditioning systems and they both relate to the refrigerant gas. The refrigerant (generic designation: R-12, trade name: Freon, a registered trademark of the DuPont Co.) is an extremely cold substance. When exposed to air, it will instantly freeze any surface it comes in contact with, including your eyes. The other hazard involves fire. Although normally non-toxic, refrigerant gas becomes highly poisonous in the presence of an open flame. One good whiff of the vapor formed by burning refrigerant can be fatal. Keep all forms of fire (including cigarettes) well clear of the air conditioning system.

Further, it is being established that the chemicals in R-12 (dichlorodifluoromethane) contribute to the damage occurring in the upper atmosphere. The time may soon come when sophisticated recovery equipment will be necessary to prevent the release of this gas when working on an air conditioning system. Any repair work should be left to a professional. Do not, under any circumstances, attempt to loosen or tighten any fittings or perform any work other than that outlined here.

SYSTEM CHECKS

A lot of A/C problems can be avoided by simply running the air conditioner at least once a week, regardless of the season. Let the system run for at least 5 minutes a week (even in the winter), and you'll keep the internal parts lubricated as well as preventing the hoses from hardening.

Oil Leaks

Refrigerant leaks show up as oily areas on the components because the compressor oil is transported around the entire system with the refrigerant. Look for oily spots on all the hoses and lines, and especially on the hose and tubing connections. If there are oily deposits, the system may have a leak. A small area of oil on the front of the compressor is normal and no cause for alarm.

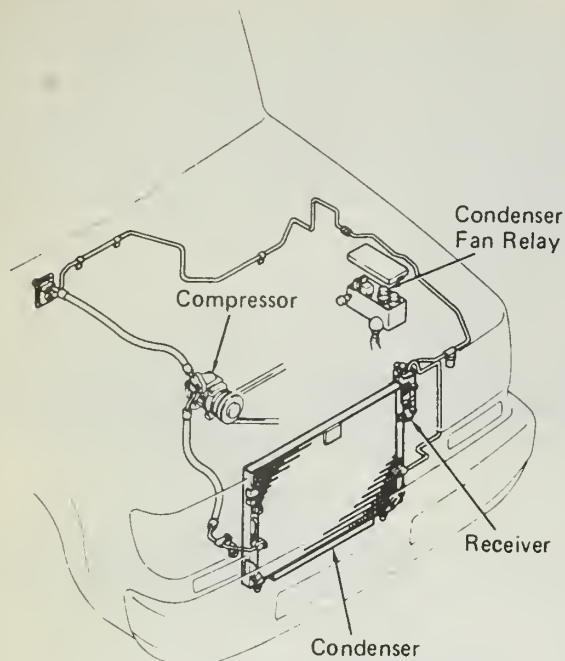
Checking the Compressor Belt

The compressor drive belt (air conditioner belt) must be checked periodically for tension and condition. A loose or slipping belt can cause poor cooling or damage to components.

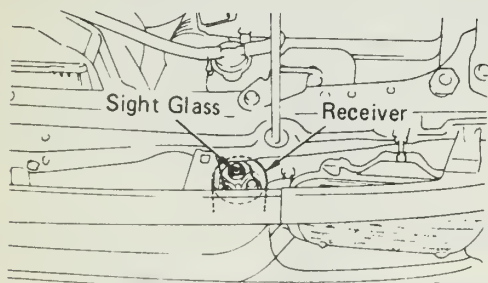
Keep the Condenser Clear

The condenser is mounted in front of the radiator (and is often mistaken for the radiator when viewed from the front of the vehicle). It serves to remove heat from the air conditioning system and cool the refrigerant. Proper air flow through the condenser is critical to the operation of the system. Periodically, inspect the front of the condenser for bent fins or foreign material

1 GENERAL INFORMATION AND MAINTENANCE



Receiver/dryer location on Land Cruisers



The receiver/dryer on trucks and 4Runners is next to the left headlamp

(dirt, bugs, paper, etc.) If any cooling fins are bent, straighten them carefully with a blunt, soft tool such as a thin piece of wood. You can remove solid debris with a stiff bristle brush (never a wire brush) or the water pressure from a hose.

Checking the Refrigerant Level

The first order of business when checking the refrigerant is to find the sight glass. It is located in the head of the receiver/drier. On trucks and 4Runners, it's located just behind the grille, near the left headlight. On Land Cruisers, it's found between the battery and the radiator. Once you've found it, wipe off the small glass window and proceed as follows:

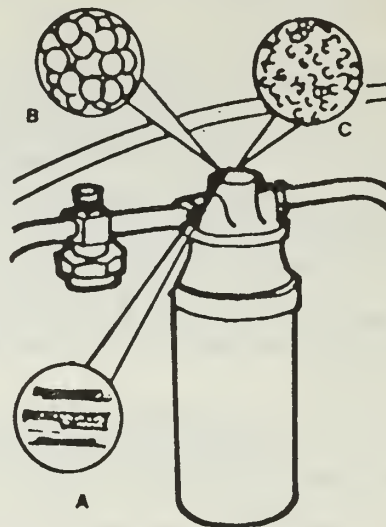
1. With the engine running and the air conditioner switched on inside the vehicle, look for the flow of refrigerant through the sight glass. If the system is working properly, you'll see a continuous flow of clear refrigerant in the sight glass, with perhaps an occasional bubble if the system is operating a high temperatures.

2. Cycle the air conditioner on and off to make sure what you are seeing is refrigerant. Since the fluid is clear, it is possible to mistake a completely discharged system for one that is fully charged. Turn the system off and watch the sight glass; if there is refrigerant in the system, you'll see bubbles during the OFF cycle. If you see no bubbles when the system is running and cold air is flowing from the air vents inside, the system is OK.

NOTE: The air conditioning system may turn itself off automatically to prevent the evaporator from freezing. If this happens while you're looking at the sight glass, don't mistake it for a failure. Wait a short while and the system will re-engage.

3. If you observe bubbles in the sight glass while the system is operating, the system is low on refrigerant. The only reason for this is a leak somewhere; have it checked by a professional.

4. Oil streaks in the sight glass are an indication of trouble. Most of the time oil will appear as a series of streaks, although it may also be a solid stream. In either case, it means reduced cooling and possibly compressor replacement.



Oil streaks (A), constant bubbles (B), or foam (C) indicate there is not enough refrigerant in the system. Occasional bubbles during initial operation are normal. A clear sight glass indicates a proper charge of refrigerant or no refrigerant at all, which can be determined by the presence of cold air at the vents. If the glass is clouded with a milky white substance, have the receiver/dryer checked professionally

GAUGES

Before attempting any charge-related work, you will need a set of A/C gauges. These are generally available from good parts suppliers and automotive tool suppliers. Generally described, this tool is a set of two gauges and three hoses. By connecting the proper hoses to the system, the gauges can be used to "see" the air conditioning system at work. The gauge set is also used to discharge and recharge the system.

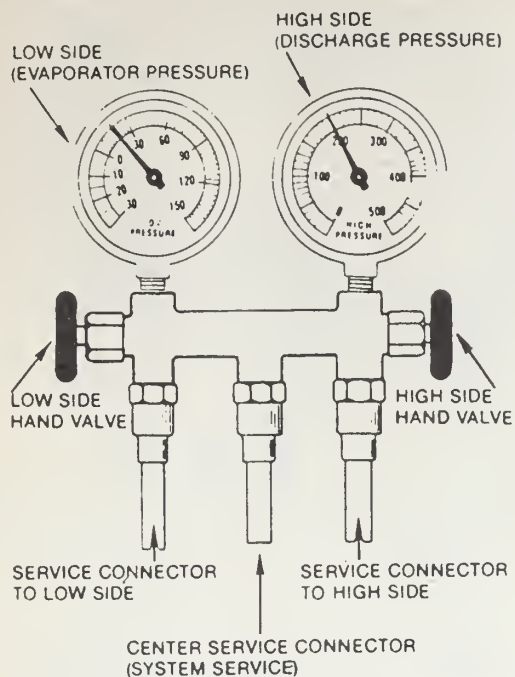
Additionally, if a component must be removed from the system, a vacuum pump will be needed to evacuate (draw vacuum) within the system to eliminate any moisture which has entered during repairs. These pumps can be purchased outright; many find it easier to rent one from a supplier on an as-needed basis.

Small cans of refrigerant will be needed; make sure you purchase enough meet the capacity of the system. Since the refrigerant is measured by weight (generally in ounces), you'll need a small scale to weigh the refrigerant can(s) as the system is recharged.

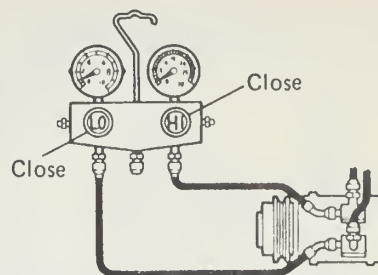
CAUTION

Wear protective goggles and gloves before proceeding with repairs.

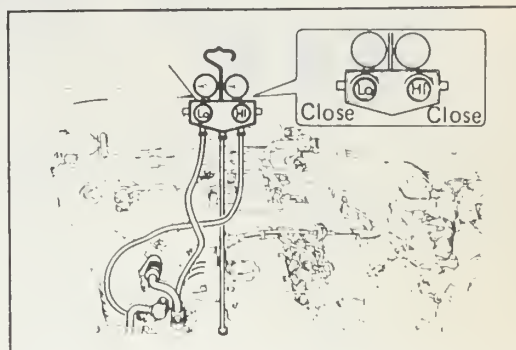
Connecting and disconnecting the gauges should always be done with the engine off to prevent injury from moving parts.



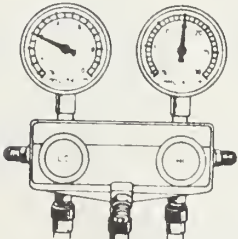
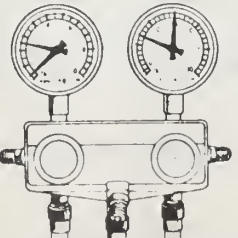
Air conditioning manifold gauge set



Manifold gauge connections, all models except 1991 Land Cruiser

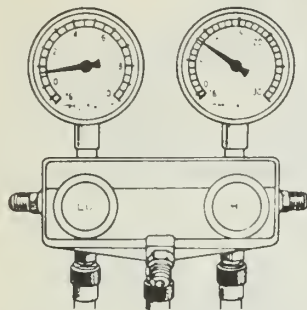
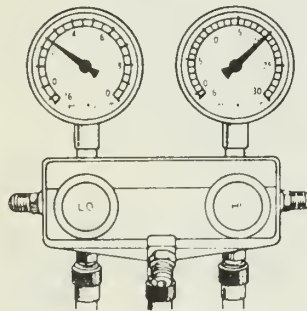


1991 Land Cruiser manifold gauge connections

No.	Gauge reading kg/cm ² (psi, kPa)	Condition	Probable cause	Remedy
1	LO: 1.5 – 2.0 (21 – 28, 147 – 196) HI: 14.5 – 15.0 (206 – 213, 1,422 – 1,471) 	Normal cooling	Normally functioning system	
2	During operation, pressure at low pressure side sometimes becomes a vacuum and sometimes normal 	Periodically cools and then fails to cool	Moisture present in refrigeration system	(1) Replace receiver (2) Remove moisture in system through repeatedly evacuating air

Using the air conditioning gauges as a diagnostic tool

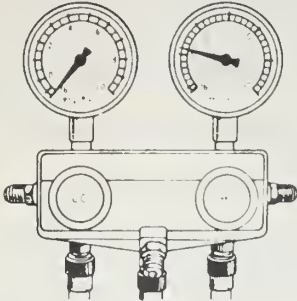
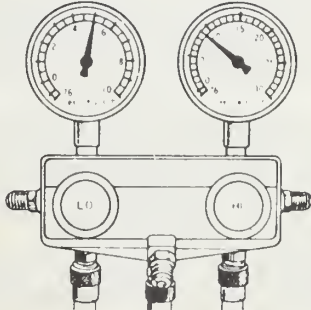
1 GENERAL INFORMATION AND MAINTENANCE

No.	Gauge reading kg/cm ² (psi, kPa)	Condition	Probable cause	Remedy	
3	Pressure low at both low and high pressure sides 	- Insufficient cooling - Bubbles seen in sight glass	Insufficient refrigerant	(1) Check for gas leakage with gas leak tester and repair if necessary (2) Add refrigerant until bubbles disappear	
		- Insufficient cooling - Frost on tubes from receiver to unit	Refrigerant flow obstructed by dirt in receiver	Replace receiver	
4	Pressure too high at both low and high pressure sides 	Insufficient cooling	Insufficient cooling of condenser	(1) Clean condenser (2) Check fan motor operation	
5			Refrigerant over-charged	(1) Check amount of refrigerant If refrigerant is over-charged (2) Recover refrigerant	
			6	Air present in system	(3) Evacuate air and charge proper amount of purified refrigerant
					(1) Replace receiver (2) Check compressor oil to see if dirty (3) Remove air in system through repeatedly evacuating air
7		- Insufficient cooling - Frost or Large amount of dew on piping at low pressure side	Expansion valve improperly mounted, heat sensing tube defective (Opens too wide)	(1) Check heat sensing tube installation condition If (1) is normal (2) Check expansion valve and replace if defective	

HINT 6:

These gauge indications are for when the refrigeration system has been opened and the refrigerant charged without evacuating air.

Using the air conditioning gauges as a diagnostic tool

No.	Gauge reading kg/cm ² (psi, kPa)	Condition	Probable cause	Remedy
8	Vacuum indicated at low pressure side, very low pressure indicated at high pressure 	- Does not cool (Cools from time to time in some cases) - Front or dew seen on piping before and after receiver or expansion valve	Refrigerant does not circulate	(1) Check heat sensing tube for gas leakage and replace expansion valve if defective If (1) is normal (2) Clean out dirt in expansion valve by blowing with air If not able to remove dirt, replace expansion valve (3) Replace receiver
9	Pressure too high at low pressure side, pressure too low at high pressure side 	Does not cool	Insufficient compression	Repair or replace compressor

Using the air conditioning gauges as a diagnostic tool

To hook up the gauges, first make sure that the valves on the gauges are turned to the closed (off) position. The high and low pressure hoses will connect the test ports on the compressor. The center hose is only used during charging or discharging the system. For pressure checks, the center hose is not used.

Discharging the System

Safety Precautions

1. Avoid contact with a charged refrigeration system, even when working on another part of the air conditioning system or vehicle. If a heavy tool comes into contact with a section of copper tubing or a heat exchanger, it can easily cause the relatively soft material to rupture.

2. When it is necessary to apply force to a fitting which contains refrigerant, as when checking that all system couplings are securely tightened, use a wrench on both parts of the fitting involved, if possible. This will avoid putting torque on refrigerant tubing. (It is advisable, when possible, to use tube or line wrenches when tightening these flare nut fittings.)

3. Do not attempt to discharge the system by merely loosening a fitting, or removing the service valve caps and cracking these valves. Precise control is possible only when using the service gauges. Place a rag under the open end of the center charging hose while discharging the system to catch any drops of liquid that might escape. Wear protective gloves when connecting or disconnecting service gauge hoses.

4. Discharge the system only in a well ventilated area. High concentrations of the gas can exclude oxygen and act as an anes-

1 GENERAL INFORMATION AND MAINTENANCE

thesia. When leak testing or soldering, this is particularly important; toxic gas is formed when R-12 contacts any flame.

5. Never start a system without first verifying that both service valves are firmly closed.

6. Avoid applying heat to any refrigerant line or storage vessel. Charging may be aided by using water heated to less than +125°F (+51°C) to warm the refrigerant container. Never allow a refrigerant storage container to sit out in the sun or near any other source of heat such as a radiator.

7. Always wear goggles when working on a system. If refrigerant contacts the eye, see a physician as soon as possible.

8. Frostbite from liquid refrigerant should be treated by first gradually warming the area with cool water, and then gently applying petroleum jelly. A physician should be consulted.

9. Always keep refrigerant can fittings capped when not in use. Avoid sudden shock to the can which might occur from dropping it or from banging a heavy tool against it. Never carry a can in the passenger compartment of a truck.

10. If the vehicle is to be baked after painting, completely discharge the system before painting.

To safely discharge the air conditioning system using the gauge set:

1. Connect the manifold gauge set.

2. Connect the red charging hose (high pressure side) of the manifold gauge to the service valve on the liquid line. Connect the blue charging hose (low pressure side) to the suction line.

3. Place the free end of the center hose into a suitable container.

4. Slowly open the high pressure hand valve to adjust the refrigerant flow.

NOTE: If you allow the refrigerant to rush out, the force will take some refrigerant oil with it. This is not desirable and may cause compressor damage.

5. Check the container to make sure that no oil is being discharged. If there is oil present in the container, partially close the hand valve.

6. After the manifold gauge reading drops below 50 psi, slowly open the low pressure valve.

7. As the system pressure drops, gradually open both high and low valves until both gauges read 0 psi.

EVACUATING AND CHARGING THE SYSTEM

NOTE: This procedure requires the use of a vacuum pump.

1. Connect the manifold gauge set.

2. Connect the center hose to the vacuum pump inlet.

3. Turn the vacuum pump on and then open both hand valves.

4. Allow the vacuum pump to operate for approximately one

half hour. Check that the low pressure gauge reads more than 600mm Hg (23.62 in. Hg/80.0 kPa) of vacuum.

NOTE: If the reading on the gauges is not more than 600mm Hg, close both valves and shut off the vacuum pump. Inspect the system for leaks and repair as necessary.

5. After the low pressure gauge shows a vacuum of more than 700mm Hg, continue evacuating for approximately 30 more minutes.

6. Close the manifold gauge valves and shut off the vacuum pump.

NOTE: After finishing evacuation of the system, always check for leaks.

7. Install the refrigerant container tap valve on the can of refrigerant.

8. Connect the center hose to the valve fitting.

9. Turn the handle clockwise to make a hole in the sealed can.

10. Turn the handle fully counterclockwise to fill the center hose with refrigerant. Do not open the high and low pressure valve.

11. Loosen the center hose nut connected to the center fitting of the manifold gauge until a hiss can be heard. This allows a small bit of refrigerant to purge air from the hose. Allow air to escape for a few seconds and then tighten the nut.

12. Hang or position the can so that it stays upright during the remaining procedure. DO NOT turn the can upside down or on its side during charging. Severe damage to the system can occur.

13. Open the low pressure valve; make certain the high pressure valve is firmly closed.

14. Open the vehicle front doors, start the engine and set the blower fan at top speed with the air conditioning system ON. Run the engine at about 1000 rpm and begin filling the system. Use a spring scale to measure the amount of refrigerant introduced into the system. Do NOT exceed the specified weight; more is not better.

15. Change cans as necessary to achieve the correct total. Remember to shut off the can control valve before changing cans.

16. When the correct weight has been delivered into the system, shut off the can control valve. Run the engine for an additional 30 seconds to clear the lines and gauges.

17. With the engine running, disconnect the low side hose from the connecting port. The disconnect the high pressure side; hold the fitting down and unscrew it quickly to avoid loss of refrigerant.

CAUTION

NEVER disconnect any gauge hose at any fitting other than the service port. Sudden loss of refrigerant could occur.

18. Replace the protective dust caps on the line fittings and shut off the engine.

Troubleshooting Basic Air Conditioning Problems

Problem	Cause	Solution
There's little or no air coming from the vents (and you're sure it's on)	• The A/C fuse is blown • Broken or loose wires or connections • The on/off switch is defective	• Check and/or replace fuse • Check and/or repair connections • Replace switch
The air coming from the vents is not cool enough	• Windows and air vent wings open • The compressor belt is slipping • Heater is on • Condenser is clogged with debris • Refrigerant has escaped through a leak in the system • Receiver/drier is plugged	• Close windows and vent wings • Tighten or replace compressor belt • Shut heater off • Clean the condenser • Check system • Service system
The air has an odor	• Vacuum system is disrupted • Odor producing substances on the evaporator case • Condensation has collected in the bottom of the evaporator housing	• Have the system checked/repared • Clean the evaporator case • Clean the evaporator housing drains
System is noisy or vibrating	• Compressor belt or mountings loose • Air in the system	• Tighten or replace belt; tighten mounting bolts • Have the system serviced
Sight glass condition		
Constant bubbles, foam or oil streaks	• Undercharged system	• Charge the system
Clear sight glass, but no cold air	• No refrigerant at all	• Check and charge the system
Clear sight glass, but air is cold	• System is OK	
Clouded with milky fluid	• Receiver drier is leaking dessicant	• Have system checked
Large difference in temperature of lines	• System undercharged	• Charge and leak test the system
Compressor noise	• Broken valves • Overcharged • Incorrect oil level • Piston slap • Broken rings • Drive belt pulley bolts are loose	• Replace the valve plate • Discharge, evacuate and install the correct charge • Isolate the compressor and check the oil level. Correct as necessary. • Replace the compressor • Replace the compressor • Tighten with the correct torque specification
Excessive vibration	• Incorrect belt tension • Clutch loose • Overcharged • Pulley is misaligned	• Adjust the belt tension • Tighten the clutch • Discharge, evacuate and install the correct charge • Align the pulley
Condensation dripping in the passenger compartment	• Drain hose plugged or improperly positioned • Insulation removed or improperly installed	• Clean the drain hose and check for proper installation • Replace the insulation on the expansion valve and hoses

1 GENERAL INFORMATION AND MAINTENANCE

Troubleshooting Basic Air Conditioning Problems (cont.)

Problem	Cause	Solution
Frozen evaporator coil	- Faulty thermostat - Thermostat capillary tube improperly installed - Thermostat not adjusted properly	- Replace the thermostat - Install the capillary tube correctly - Adjust the thermostat
Low side low—high side low	- System refrigerant is low - Expansion valve is restricted	- Evacuate, leak test and charge the system - Replace the expansion valve
Low side high—high side low	Internal leak in the compressor—worn	Remove the compressor cylinder head and inspect the compressor. Replace the valve plate assembly if necessary. If the compressor pistons, rings or
Low side high—high side low (cont.)	- Cylinder head gasket is leaking - Expansion valve is defective - Drive belt slipping	- cylinders are excessively worn or scored replace the compressor - Install a replacement cylinder head gasket - Replace the expansion valve - Adjust the belt tension
Low side high—high side high	- Condenser fins obstructed - Air in the system - Expansion valve is defective - Loose or worn fan belts	- Clean the condenser fins - Evacuate, leak test and charge the system - Replace the expansion valve - Adjust or replace the belts as necessary
Low side low—high side high	- Expansion valve is defective - Restriction in the refrigerant hose	- Replace the expansion valve - Check the hose for kinks—replace if necessary
Low side low—high side high	- Restriction in the receiver/drier - Restriction in the condenser	- Replace the receiver/drier - Replace the condenser
Low side and high normal (inadequate cooling)	- Air in the system - Moisture in the system	- Evacuate, leak test and charge the system - Evacuate, leak test and charge the system

Windshield Wipers

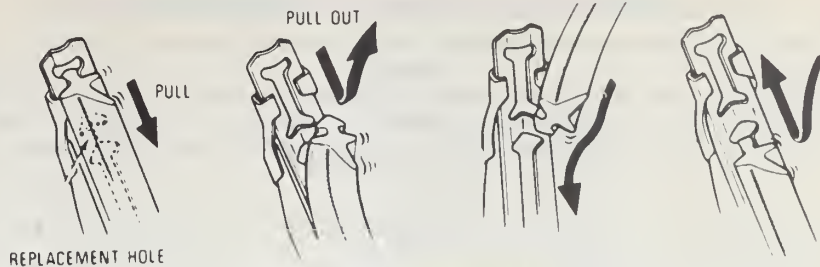
For maximum effectiveness and longest element life, the windshield and wiper blades should be kept clean. Dirt, tree sap, road tar and so on will cause streaking, smearing and blade deterioration if left on the glass. It is advisable to wash the windshield carefully with a commercial glass cleaner at least once a month. Wipe off the rubber blades with the wet rag afterwards. Do not attempt to move the wipers across the windshield by hand; damage to the motor and drive mechanism will result. The wiper arms are hinged at the bottom and may be lifted away from the glass.

If the blades are found to be cracked, broken or torn, they should be replaced immediately. Replacement intervals will vary with usage, although ozone deterioration and ultraviolet

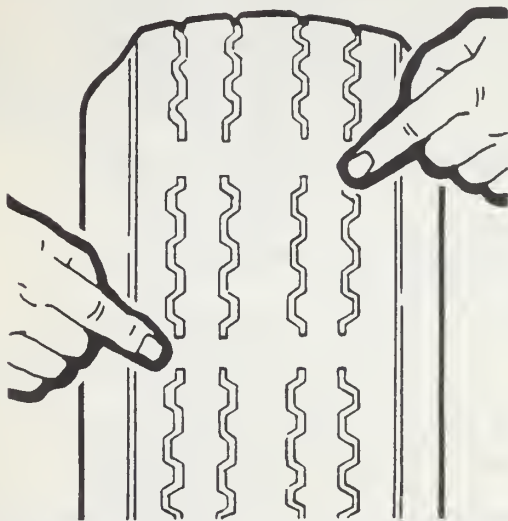
rays usually limit blade life to about 6 months. If the wiper pattern is smeared or streaked, or if the blade chatters across the glass, the elements should be replaced. It is easiest and most sensible to replace the elements in pairs. If the proper source can be found, it is only necessary to replace the rubber blades or inserts; replacing the entire holder is not required.

To replace the inserts:

1. Pull the top end of the insert inward until the blade is free of the end slot. The replacement hole should be visible.
2. Pull the insert out through the hole.
3. Install the new blade by inserting the end with the small dot(s) into the replacement hole.
4. Work the insert along the slot in the frame.
5. When all of the rubber is in the frame slot, allow it to expand back up to the tip of the frame. Make certain the blade is locked in place and cannot creep out during use.



Toyota wiper blade Inserts are easily replaced



All tires are built with a wear indicator bar. When two are exposed, it's time for new tires

Tires and Wheels

Inspect the tires regularly for wear and damage. Remove stones or other foreign particles which may be lodged in the tread. If tread wear is excessive or irregular it could be a sign of front end problems, or simply improper inflation.

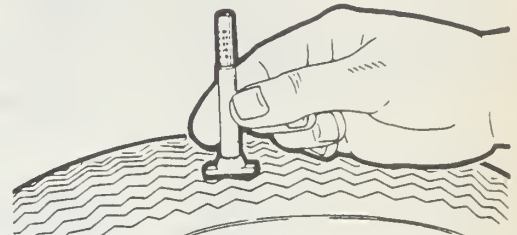
The inflation should be checked at least once per month and adjusted if necessary. Always use a tire gauge; it is impossible to read tire inflation pressure by looking at the tire. Radial tires have a characteristic sidewall bulge even when correctly inflated. This is easily misinterpreted as a soft tire. The tires must be cold (driven less than one mile) or an inaccurate reading will result. Do not forget to check the spare.

The correct inflation pressure for your vehicle can be found on a decal mounted to the truck. Depending upon model and year, the decal can be located at the driver's door, the passenger's door or the glove box. If you cannot find the decal, a local tire dealer can furnish you with information.

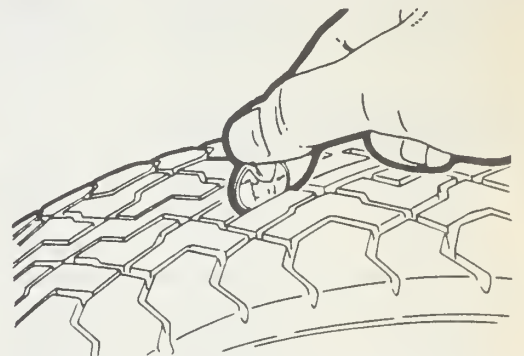
Inspect tires for uneven wear that might indicate the need for front end alignment or tire rotation. Tires should be replaced when a tread wear indicator appears as a solid band across the tread.

When you buy new tires, give some thought to these points, especially if you are switching to larger tires or to another profile series (50, 60, 70, 78):

1. The wheels must be the correct width for the tire. Tire



An inexpensive tire tread gauge is a useful tool. Tire wear indicators appear at about $\frac{3}{32}$ inch of remaining tread



An inverted penny serves as a quick tread check. If the top of Lincoln's head is not visible, the tread is serviceable

dealers have charts of tire and rim compatibility. A mismatch can cause sloppy handling and rapid tread wear.

2. The height (mounted diameter) of the new tires can greatly change speedometer accuracy, engine speed at a given road speed, fuel mileage, acceleration, and ground clearance. Tire makers furnish full measurement specifications. Speedometer drive gears are available from Toyota dealers for correction.

NOTE: Dimensions of tires marked the same size may vary significantly, even among tires from the same maker.

3. The spare tire should be usable, at least for low speed operation, with the new tires.

4. There shouldn't be any body interference when loaded, on bumps, or in turning.

The only sure way to avoid problems with these points is to stick to tire and wheel sizes available as factory options.

TIRE ROTATION

The rotation is recommended every 6000 miles, except on trucks with dual rear wheels. The pattern you use depends on whether or not your car has a usable spare. Radial tires should not be cross-switched (from one side of the car to the other); they last longer if their direction of rotation is not changed. Snow tires sometimes have directional arrows molded into the

1 GENERAL INFORMATION AND MAINTENANCE

Troubleshooting Basic Wheel Problems

Problem	Cause	Solution
The car's front end vibrates at high speed	• The wheels are out of balance • Wheels are out of alignment	• Have wheels balanced • Have wheel alignment checked/adjusted
Car pulls to either side	• Wheels are out of alignment • Unequal tire pressure • Different size tires or wheels	• Have wheel alignment checked/adjusted • Check/adjust tire pressure • Change tires or wheels to same size
The car's wheel(s) wobbles	• Loose wheel lug nuts • Wheels out of balance • Damaged wheel • Wheels are out of alignment • Worn or damaged ball joint • Excessive play in the steering linkage (usually due to worn parts) • Defective shock absorber	• Tighten wheel lug nuts • Have tires balanced • Raise car and spin the wheel. If the wheel is bent, it should be replaced • Have wheel alignment checked/adjusted • Check ball joints • Check steering linkage • Check shock absorbers
Tires wear unevenly or prematurely	• Incorrect wheel size • Wheels are out of balance • Wheels are out of alignment	• Check if wheel and tire size are compatible • Have wheels balanced • Have wheel alignment checked/adjusted

Troubleshooting Basic Tire Problems

Problem	Cause	Solution
The car's front end vibrates at high speeds and the steering wheel shakes	• Wheels out of balance • Front end needs aligning	• Have wheels balanced • Have front end alignment checked
The car pulls to one side while cruising	• Unequal tire pressure (car will usually pull to the low side) • Mismatched tires • Front end needs aligning	• Check/adjust tire pressure • Be sure tires are of the same type and size • Have front end alignment checked
Abnormal, excessive or uneven tire wear	• Infrequent tire rotation • Improper tire pressure	• Rotate tires more frequently to equalize wear • Check/adjust pressure
See "How to Read Tire Wear"	• Sudden stops/starts or high speed on curves	• Correct driving habits
Tire squeals	• Improper tire pressure • Front end needs aligning	• Check/adjust tire pressure • Have front end alignment checked

Tire Size Comparison Chart

"Letter" sizes			Inch Sizes	Metric-inch Sizes		
"60 Series"	"70 Series"	"78 Series"	1965-77	"60 Series"	"70 Series"	"80 Series"
		Y78-12	5.50-12, 5.60-12 6.00-12	165/60-12	165/70-12	155-12
		W78-13	5.20-13	165/60-13	145/70-13	135-13
		Y78-13	5.60-13	175/60-13	155/70-13	145-13
			6.15-13	185/60-13	165/70-13	155-13, P155/80-13
A60-13	A70-13	A78-13	6.40-13	195/60-13	175/70-13	165-13
B60-13	B70-13	B78-13	6.70-13	205/60-13	185/70-13	175-13
			6.90-13			
C60-13	C70-13	C78-13	7.00-13	215/60-13	195/70-13	185-13
D60-13	D70-13	D78-13	7.25-13			
E60-13	E70-13	E78-13	7.75-13			195-13
			5.20-14	165/60-14	145/70-14	135-14
			5.60-14	175/60-14	155/70-14	145-14
			5.90-14			
A60-14	A70-14	A78-14	6.15-14	185/60-14	165/70-14	155-14
	B70-14	B78-14	6.45-14	195/60-14	175/70-14	165-14
	C70-14	C78-14	6.95-14	205/60-14	185/70-14	175-14
D60-14	D70-14	D78-14				
E60-14	E70-14	E78-14	7.35-14	215/60-14	195/70-14	185-14
F60-14	F70-14	F78-14, F83-14	7.75-14	225/60-14	200/70-14	195-14
G60-14	G70-14	G77-14, G78-14	8.25-14	235/60-14	205/70-14	205-14
H60-14	H70-14	H78-14	8.55-14	245/60-14	215/70-14	215-14
J60-14	J70-14	J78-14	8.85-14	255/60-14	225/70-14	225-14
L60-14	L70-14		9.15-14	265/60-14	235/70-14	
	A70-15	A78-15	5.60-15	185/60-15	165/70-15	155-15
B60-15	B70-15	B78-15	6.35-15	195/60-15	175/70-15	165-15
C60-15	C70-15	C78-15	6.85-15	205/60-15	185/70-15	175-15
	D70-15	D78-15				
E60-15	E70-15	E78-15	7.35-15	215/60-15	195/70-15	185-15
F60-15	F70-15	F78-15	7.75-15	225/60-15	205/70-15	195-15
G60-15	G70-15	G78-15	8.15-15/8.25-15	235/60-15	215/70-15	205-15
H60-15	H70-15	H78-15	8.45-15/8.55-15	245/60-15	225/70-15	215-15
J60-15	J70-15	J78-15	8.85-15/8.90-15	255/60-15	235/70-15	225-15
	K70-15		9.00-15	265/60-15	245/70-15	230-15
L60-15	L70-15	L78-15, L84-15	9.15-15			235-15
	M70-15	M78-15				255-15
		N78-15				

NOTE: Every size tire is not listed and many size comparisons are approximate, based on load ratings. Wider tires than those supplied new with the vehicle should always be checked for clearance

side of the carcass; the arrow shows the direction of rotation. They will wear very rapidly if the rotation is reversed. Studded tires will lose their studs if their rotational direction is reversed.

NOTE: Mark the wheel position or direction of rotation on radial tires or studded snow tires before removing them.

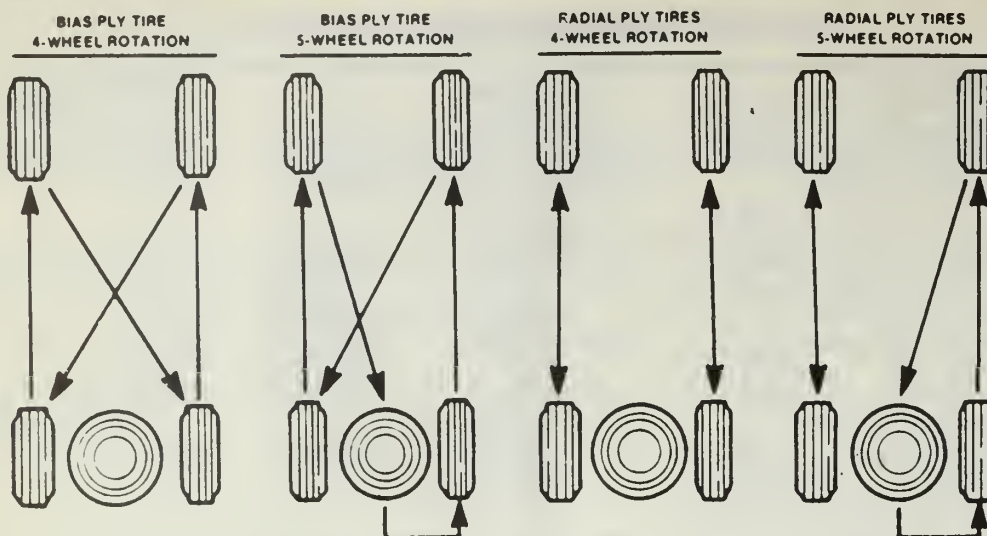
If your truck is equipped with tires having different load ratings on the front and the rear, the tires should not be rotated front to rear. Rotating these tires could affect tire life (the tires with the lower rating will wear faster, and could become overloaded), and upset the handling of the truck.

TIRE USAGE

The tires on your truck were selected to provide the best all around performance for normal operation when inflated as specified. Oversize tires will not increase the load carrying capacity of the truck, although they will provide an extra margin of tread life. Be sure to check overall height before using larger size tires which may cause interference with suspension components or wheel wells. When replacing conventional tire sizes with other tire size designations, be sure to check the manufacturer's recommendations.

Interchangeability is not always possible because of differ-

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Tire rotation patterns. Note that the spare may be included or omitted during rotation

ences in load ratings, tire dimensions, wheel well clearances, and rim size. Also due to differences in handling characteristics, 70 Series and 60 Series tires should be used only in pairs on the same axle; radial tires should be used only in sets of four.

Toyota strongly recommends that snow tires be fitted to all 4 wheels. This improves vehicle stability in slick conditions and prevents one end from attempting to pass the other.

TIRE DESIGN

For maximum satisfaction, tires should be used in sets of five. Mixing or different types (radial, bias-belted, fiberglass belted) should be avoided. Conventional bias tires are constructed so that the cords run bead-to-bead at an angle. Alternate plies run at an opposite angle. This type of construction gives rigidity to both tread and sidewall. Bias-belted tires are similar in construction to conventional bias ply tires. Belts run at an angle and also at a 90° angle to the bead, as in the radial tire. Tread life is improved considerably over the conventional bias tire. The radial tire differs in construction, but instead of the carcass plies running at an angle of 90° to each other, they run at an angle of 90° to the bead. This gives the tread a great deal of rigidity and the sidewall a great deal of flexibility and accounts for the characteristic bulge associated with radial tires.

Radial tires are recommended for use on all Toyota trucks. If they are used, tire sizes and wheel diameters should be selected to maintain ground clearance and tire load capacity equivalent to the minimum specified tire. Radial tires should always be used in sets of five, but in an emergency radial tires can be used with caution on the rear axle only. If this is done, both tires on the rear should be of radial design.

NOTE: Radial tires should never be used on only one axle.

STORAGE

Store the tires at the proper inflation pressure if they are mounted on wheels. Keep them in a cool, dry place, laid on their sides. If the tires are stored in the garage or basement, do not let them stand on a concrete floor; set them on strips of wood or thick stacks of newspapers.

CARE OF SPECIAL WHEELS

If you have invested money in magnesium, aluminum alloy or sport wheels, special precautions should be taken to make sure your investment is not wasted and that your special wheels look good for the lifetime of the vehicle.

Special wheels are easily scratched and/or damaged, occasionally check the rims for cracking, impact damage or air leaks, if any of these are found, replace the wheel. In order to prevent this type of damage, and the costly replacement of a wheel, observe the following precautions:

- Use extra care not to damage the wheels during removal, installation, balancing, etc. After removal of the wheels, place them in a safe location away from the work area. If they are to be stored, never stand them upright; the tread will develop flat spots.
- While driving, avoid obstacles, holes, and sharp objects.
- When washing, use a mild detergent and water. Avoid cleanser with abrasives or the use of hard brushes. There are many cleaners and polishes for special wheels—use them.
- If possible, remove the special wheels from the vehicle during the winter months. Salt and sand used for snow removal can severely damage the finish. Never install snow chains over special wheels; severe damage may occur.
- Make sure the recommended lug nut torque is never exceeded or the wheel may crack. Always hand tighten the lugs in a criss-cross pattern.

FLUIDS AND LUBRICANTS

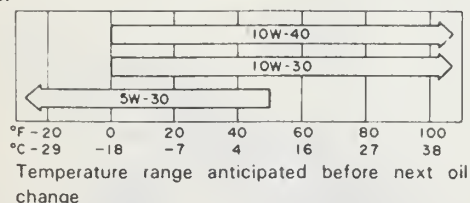
Oil and Fuel Recommendations

OIL

The SAE (Society of Automotive Engineers) grade number indicates the viscosity of the engine oil; its resistance to flow at a given temperature. The lower the SAE grade number, the lighter the oil. For example, the mono-grade oils begin with SAE 5 weight, which is a thin, light oil, and continue in viscosity up to SAE 80 or 90 weight, which are heavy gear lubricants. These oils are also known as "straight weight", meaning they are of a single viscosity, and do not vary with engine temperature.

Multi-viscosity oils offer the important advantage of being adaptable to temperature extremes. These oils have designations such as 10W-40, 20W-50, etc. The "10W-40" means that in winter (the "W" in the designation) the oil acts like a thin 10 weight oil, allowing the engine to spin easily when cold and offering rapid lubrication. Once the engine has warmed up, however, the oil acts like a straight 40 weight, maintaining good lubrication and protection for the engine's internal components. A 20W-50 oil would therefore be slightly heavier than and not as ideal in cold weather as the 10W-40, but would offer better protection at higher rpm and temperatures because when warm it acts like a 50 weight oil. Whichever oil viscosity you choose when changing the oil, make sure you are anticipating the temperatures your engine will be operating in until the oil is changed again. Refer to the oil viscosity chart for oil recommendations according to temperature.

The API (American Petroleum Institute) designation indicates the classification of engine oil used under certain given operating conditions. Only oils designated for use "Service SG" should be used. Oils of the SG type perform a variety of functions inside the engine in addition to the basic function as a lubricant. Through a balanced system of metallic detergents and polymeric dispersants, the oil prevents the formation of high and low temperature deposits and also keeps sludge and particles of dirt in suspension. Acids, particularly sulfuric acid, as well as other by-products of combustion, are neutralized. Both the SAE grade number and the API designation can be found on top of the oil can. For recommended oil viscosities, refer to the chart.



Recommended oil viscosity; all trucks, 4Runners and Land Cruisers

Synthetic Oil

There are many excellent synthetic oils currently available that can provide better gas mileage, longer service life, and in some cases better engine protection. These benefits do not come without a few hitches, however; the main one being the price of synthetic oils, which is three or four times the price per quart of conventional oil.

Synthetic oil is not for every truck and every type of driving, so you should consider your engine's condition and your type of driving. Also, check your truck's warranty conditions regarding the use of synthetic oils.

Both brand new engines and older, high mileage engines are the wrong candidates for synthetic oil. The synthetic oils are so slippery that they can prevent the proper break-in of new en-

gines; most manufacturers recommend that you wait until the engine is properly broken in (3,000 miles) before using synthetic oil. Older engines with wear have a different problem with synthetics: they "use" (consume during operation) more oil as they age. Slippery synthetic oils get past these worn parts easily. If your engine is "using" conventional oil, it will use synthetics much faster. Also, if your truck is leaking oil past old seals you'll have a much greater leak problem with synthetics.

Consider your type of driving. If most of your accumulated mileage is high speed, highway type driving, the more expensive synthetic oils may be a benefit. Extended highway driving gives the engine a chance to warm up, accumulating less acids in the oil and putting less stress on the engine over the long run. Trucks with synthetic oils may show increased fuel economy in highway driving, due to less internal friction.

If synthetic oil is used, it should still be replaced at regular intervals as stated in the maintenance schedule. While the oil itself will last much longer than regular oil, pollutants such as soot, water and unburned fuel still accumulate within the oil. These are the damaging elements within a motor and must be drained regularly to prevent damage.

Trucks used under harder circumstances, such as stop-and-go, city type driving, short trips, or extended idling, should be serviced more frequently. For the engines in these trucks, the much greater cost of synthetic or fuel-efficient oils may not be worth the investment. Internal wear increases much quicker on these trucks, causing greater oil consumption and leakage.

NOTE: The mixing of conventional and synthetic oils is not recommended. If you are using synthetic oil, it might be wise to carry two or three quarts with you no matter where you drive, as not all service stations carry this type of lubricant.

Non-detergent or straight mineral oils must never be used.

FUEL

It is important to use fuel of the proper octane rating in your truck. Octane rating is based on the quantity of anti-knock compounds added to the fuel and it determines the speed at which the gas will burn. The lower the octane rating, the faster it burns. The higher the octane, the slower the fuel will burn and a greater percentage of compounds in the fuel prevent spark ping (knock), detonation and pre-ignition (dieseling).

As the temperature of the engine increases, the air/fuel mixture exhibits a tendency to ignite before the spark plug is fired. If fuel of an octane rating too low for the engine is used, this will allow combustion to occur before the piston has completed its compression stroke, thereby creating a very high pressure very rapidly.

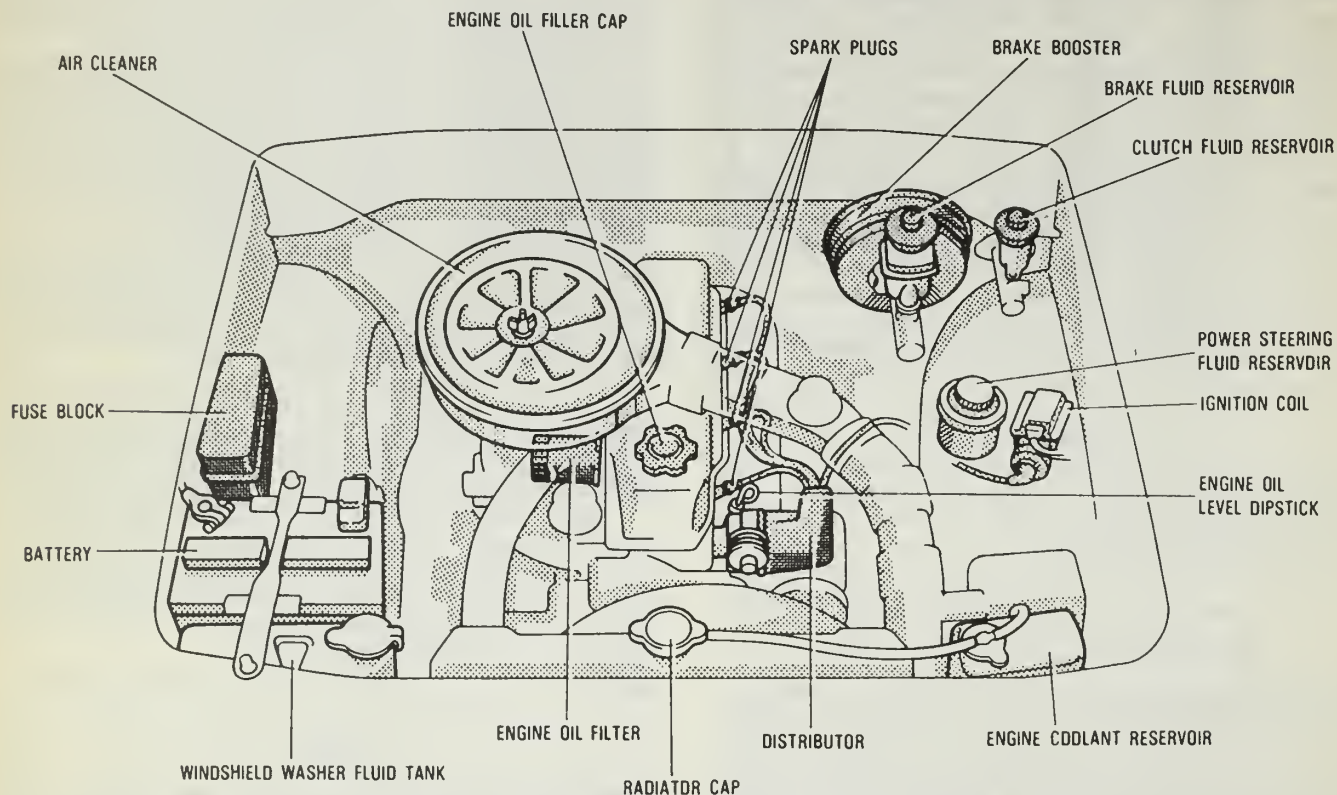
Fuel of the proper octane rating, for the compression ratio and ignition timing of your truck, will slow the combustion process sufficiently to allow the spark plug enough time to ignite the mixture completely and smoothly. The use of some super-premium fuel is no substitution for a properly tuned and maintained engine. Chances are that if your engine exhibits any signs of spark ping, detonation or pre-ignition when using regular fuel, the ignition timing should be checked against specifications or the cylinder head should be removed for decarbonizing.

Vehicles equipped with catalytic converters must use UNLEADED GASOLINE only. Use of leaded fuel shortens the life of spark plugs, exhaust systems and EGR valves and can damage the catalytic converter. Most converter equipped models are designed to operate using unleaded gasoline with a minimum rating of 91 octane. Use of unleaded gas with octane ratings lower than 91 can cause persistent spark knock which could lead to engine damage.

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Light spark knock may be noticed when accelerating or driving up hills, particularly with a carbureted engine. The slight knocking may be considered normal (with 91 octane) because the maximum fuel economy is obtained under condition of occasional light spark knock. Gasoline with an octane rating higher than 91 may be used, but it is not necessary (in most cases) for proper operation.

NOTE: Your engine's fuel requirement can change with time, mainly due to carbon buildup, which changes the compression ratio. If your engine pings, knocks or runs on, switch to a higher grade of fuel. Sometimes just changing brands will cure the problem. If it becomes necessary to retard the timing from specifications, don't change it more than a few degrees. Retarded timing will reduce power output and fuel mileage and will increase the engine temperature.



Engine compartment service component locations — 22R engine

Engine

CAUTION

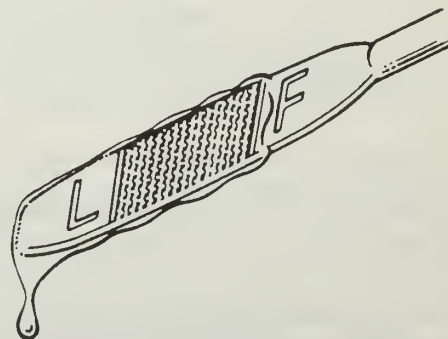
Prolonged and repeated skin contact with used engine oil, with no effort to remove the oil, may be harmful. Always follow these simple precautions when handling used motor oil:

- Avoid prolonged skin contact with used motor oil.
- Remove oil from skin by washing thoroughly with soap and water or waterless hand cleaner. Do not use gasoline, thinners or other solvents.
- Avoid prolonged skin contact with oil-soaked clothing.

OIL LEVEL CHECK

Every time you stop for fuel, check the engine oil as follows:

1. Park the truck on level ground.
2. When checking the oil level it is best for the engine to be at operating temperature, although checking the oil immediately after a stopping will lead to a false reading. Wait a few minutes after turning off the engine to allow the oil to drain back into the oil pan (crankcase).
3. Open the hood and locate the dipstick. Pull the dipstick from its tube, wipe it clean and reinsert it.
4. Pull the dipstick out again and, holding it horizontally,

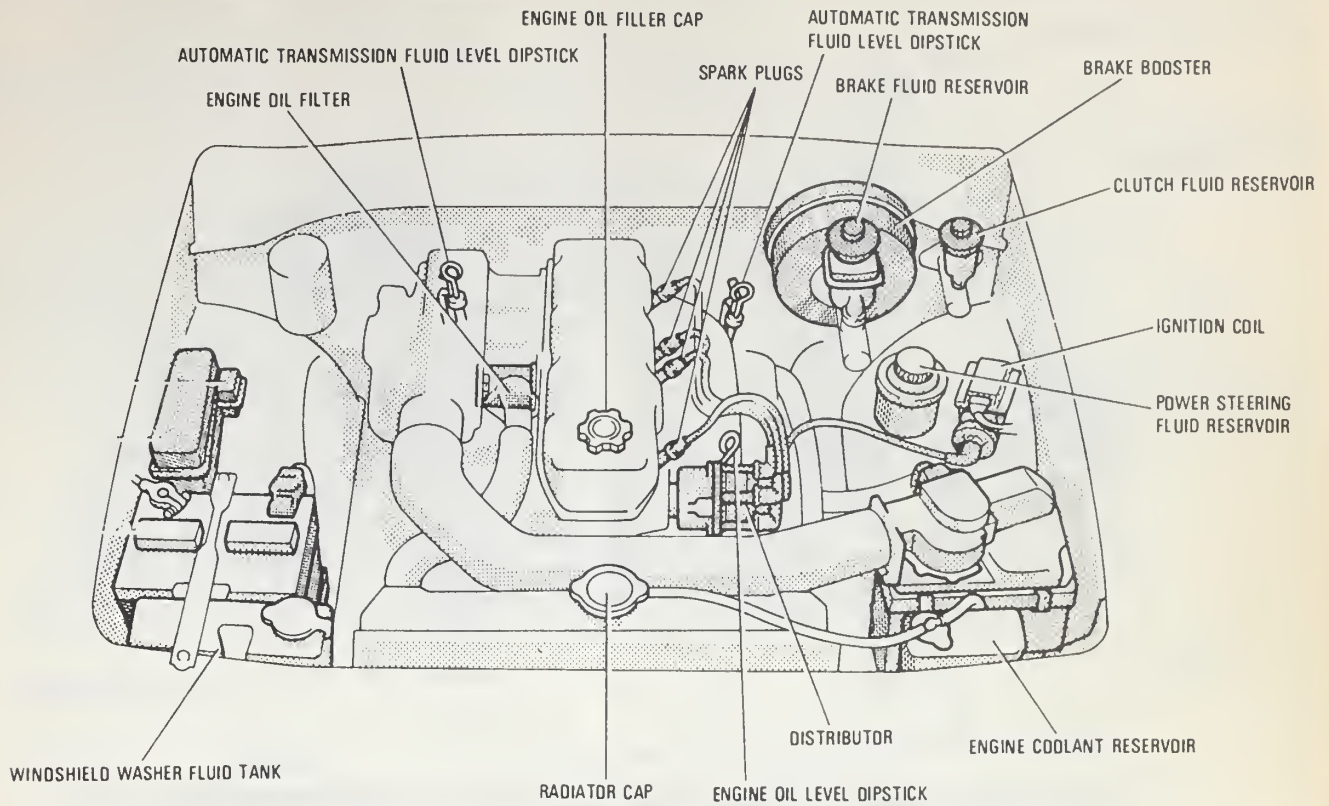


Engine oil dipstick markings

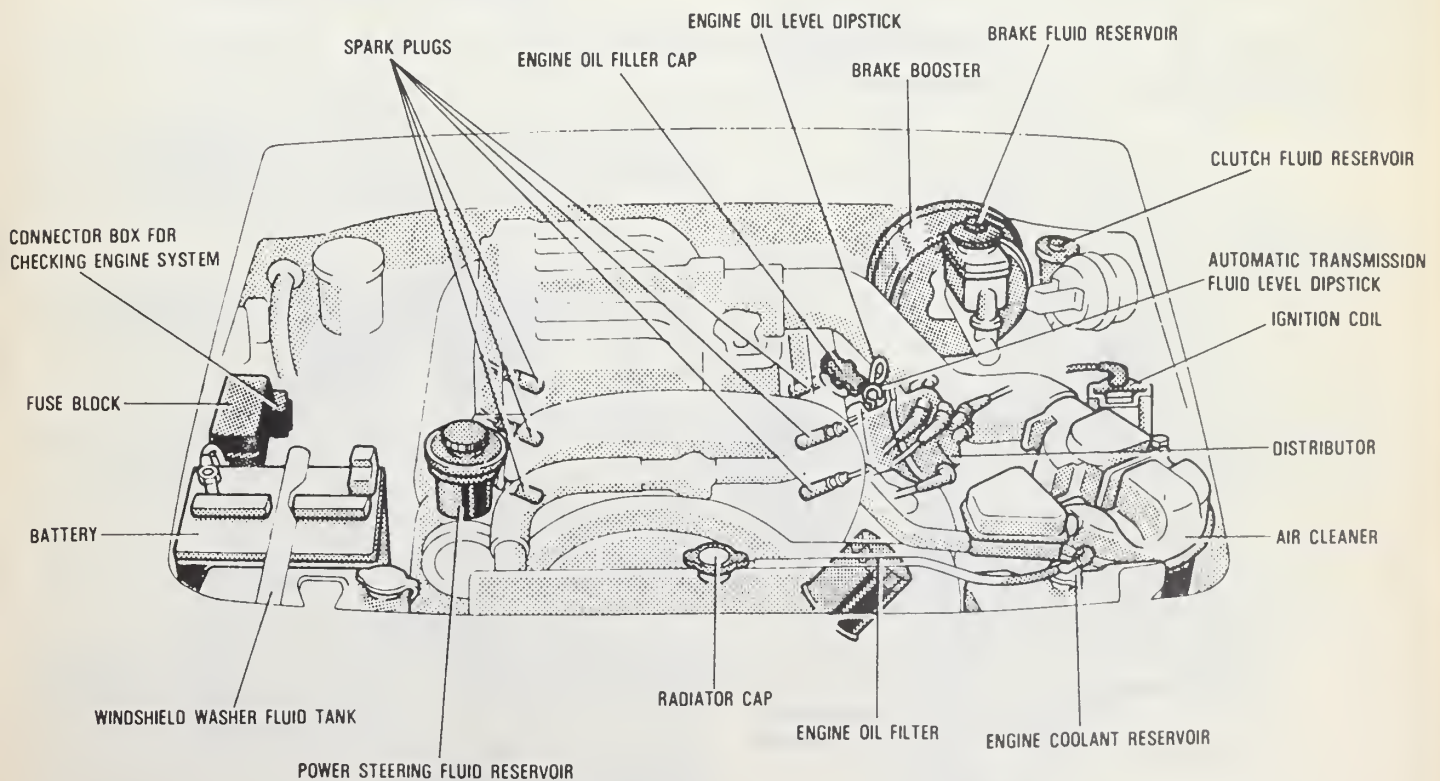
read the oil level. The oil should be between the F and L marks on the dipstick. If the oil is below the L mark, add oil of the proper viscosity through the capped opening on the top of the cylinder head cover.

5. Replace the dipstick and check the oil level again after adding any oil. Be careful not to overfill the crankcase. Approximately one quart of oil will raise the level from the L to the F. Excess oil will generally be consumed at an accelerated rate as well as hampering engine operation..

GENERAL INFORMATION AND MAINTENANCE 1

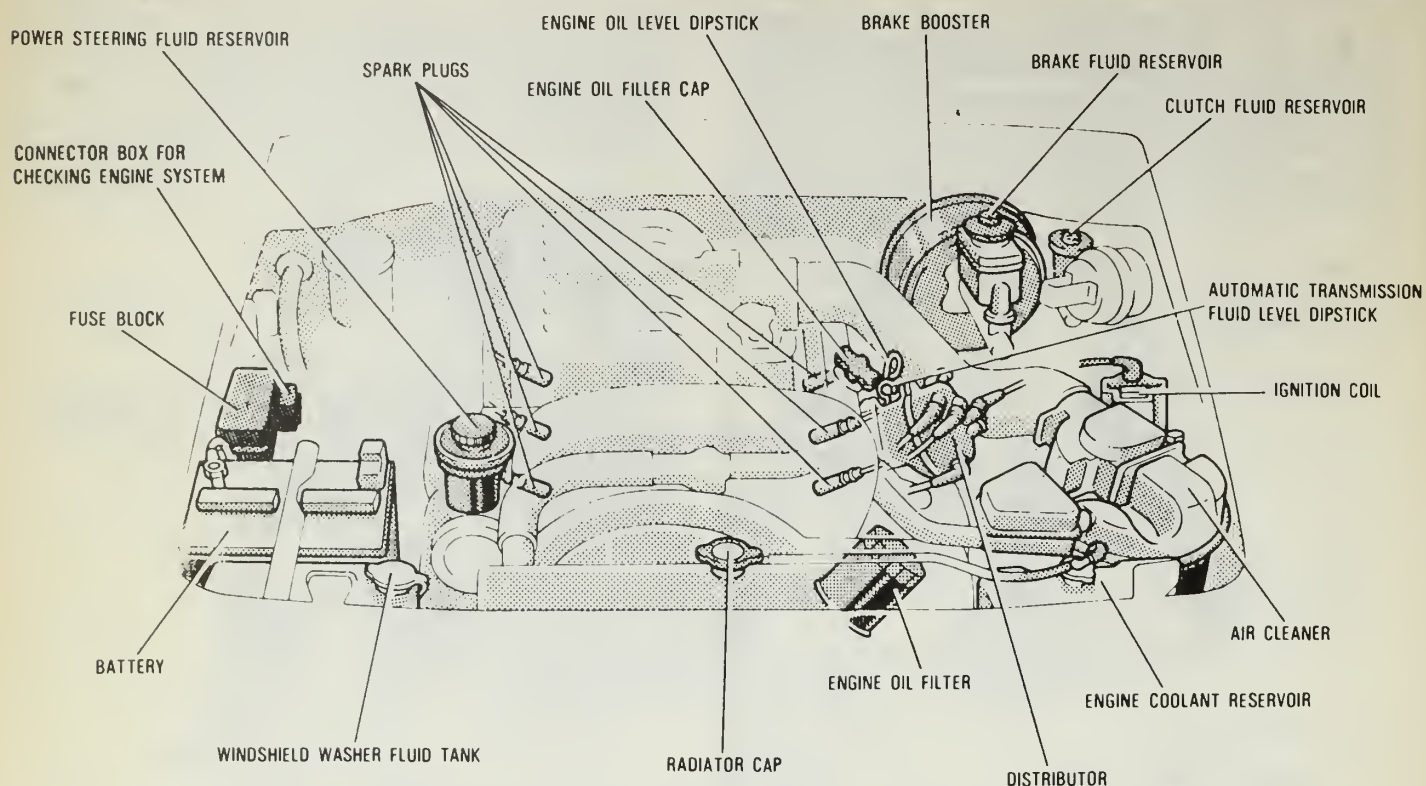


Engine compartment service component locations – 22R-E engine

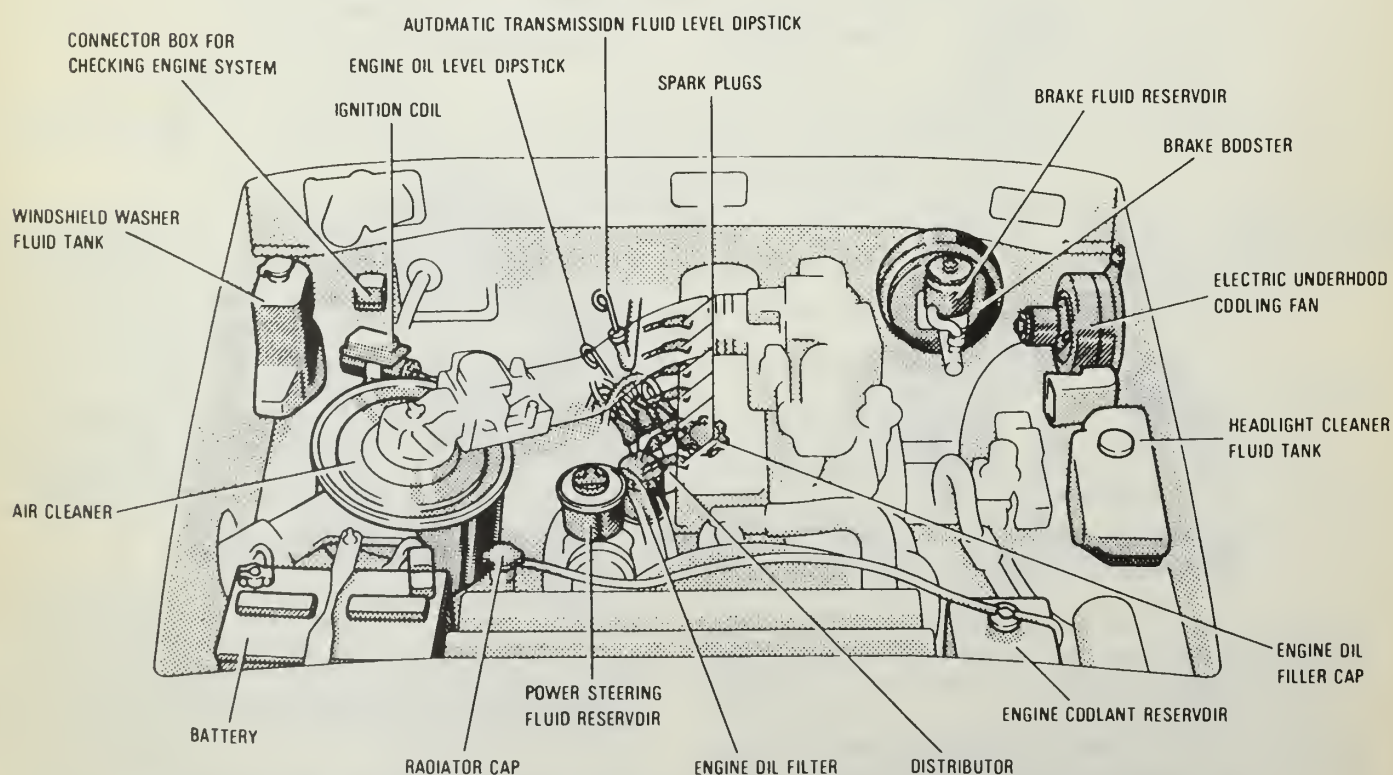


Engine compartment service component locations – 3VZ-E truck engine

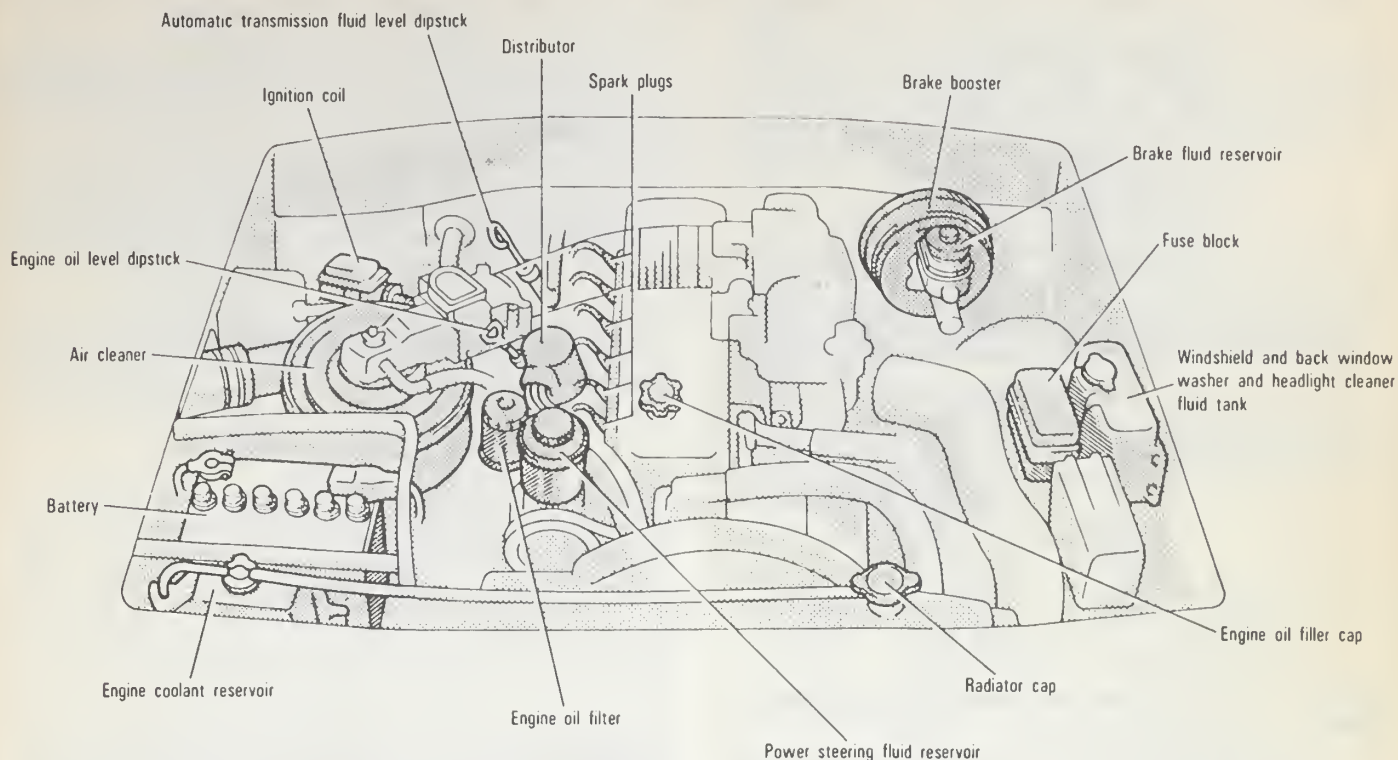
1 GENERAL INFORMATION AND MAINTENANCE



Engine compartment service component locations — 3VZ-E 4Runner engine



Engine compartment service component locations — 3F-E engine in 1989-90 Land Cruiser



Engine compartment service component locations — 3F-E engine in 1991 Land Cruiser

OIL AND FILTER CHANGE

The oil and filter should be changed every 7500 miles (12,000 km).

CAUTION

Used motor oil may cause skin cancer if repeatedly left in contact with the skin for prolonged periods. Although this is unlikely unless you handle oil on a daily basis, it is wise to thoroughly wash your hands with soap and water immediately after handling used motor oil.

- Avoid prolonged skin contact with used motor oil.
- Remove oil from skin by washing thoroughly with soap and water or waterless hand cleaner. Do not use gasoline, thinners or other solvents.

- Avoid prolonged skin contact with oil-soaked clothing.

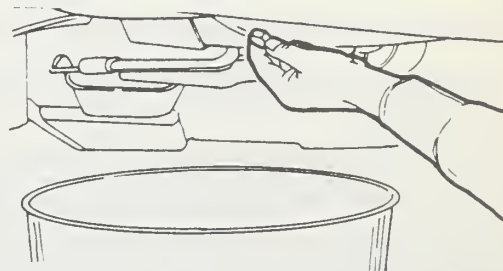
The oil drain plug is located on the bottom, rear of the oil pan (bottom of the engine, underneath the truck). The oil filter is located on the side of the engine.

The mileage figures given are the Toyota recommended intervals assuming normal driving and conditions. Normal driving requires that the vehicle be driven far enough to warm up the oil; usually this is about 10 miles or so. If your everyday use is shorter than this (one way), your use qualifies as severe duty.

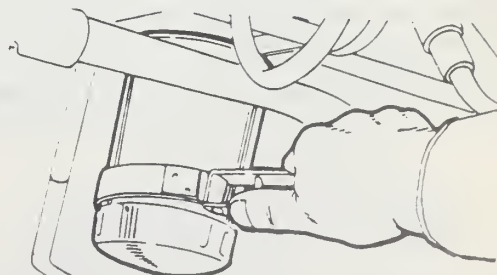
Severe duty includes dusty, polluted or off-road conditions, as well as stop-and-go short haul uses. Regularly towing a trailer also puts the truck in this category, as does constant operation with a near capacity load. Change the oil and filter at $\frac{1}{2}$ the normal interval. Half of 7500 equals 3250 miles; round it down to the easily remembered 3000 mile interval. For some owners, that may be once a month; for others, it may be six months.

Always drain the oil after the engine has been running long enough to bring it to normal operating temperature. Hot oil will flow easier and more contaminants will be removed along with the oil than if it were drained cold. To change the oil and filter:

1. Run the engine until it reaches normal operating temperature.
2. Jack up the front of the truck and support it on safety stands.
3. Slide a drain pan of at least 6 quarts capacity under the oil pan.

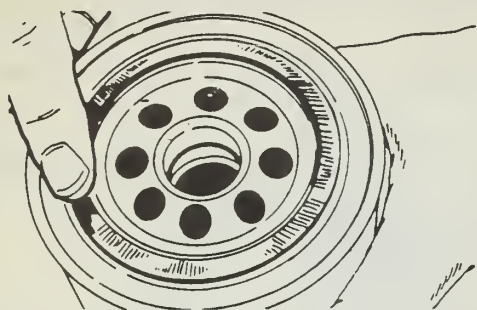


Keeping upward pressure on the drain plug while unscrewing it will prevent oil leakage until you're ready for it

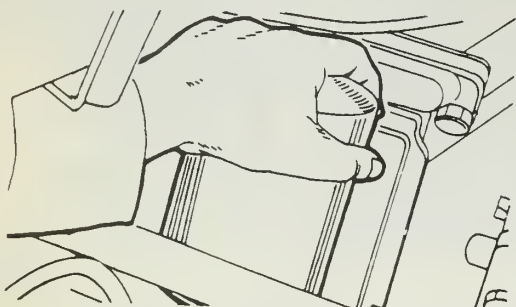


An oil filter wrench is very handy. Don't bang other components with the handle when turning

1 GENERAL INFORMATION AND MAINTENANCE



Lubricate the gasket on the new filter with clean engine oil. A dry gasket may not seal correctly



Install the new filter by hand; do not over tighten the filter

4. Loosen the drain plug with a wrench. Turn the plug out by hand. By keeping an inward pressure on the plug as you unscrew it, oil won't escape past the threads and you can remove it without being burned by hot oil.

5. Allow the oil to drain completely and then install the drain plug. Don't overtighten the plug, or you'll be buying a new pan or a replacement plug for stripped threads.

6. Using a filter wrench, remove the oil filter. Keep in mind that it's holding about one quart of dirty, hot oil. Make certain the old gasket comes off with the filter and is not stuck to the block.

7. Empty the old filter into the drain pan and dispose of the filter.

8. Using a clean rag, wipe off the filter adapter on the engine block. Be sure that the rag doesn't leave any lint which could clog an oil passage.

9. Coat the rubber gasket on the filter with fresh oil. Spin it onto the engine by hand; when the gasket touches the adapter surface give it another $\frac{1}{2}$ – $\frac{3}{4}$ turn. No more, or you'll squash the gasket and it will leak.

10. Refill the engine with the correct amount of fresh oil. See the "Capacities" chart.

11. Check the oil level on the dipstick. It is normal for the level to be a bit above the full mark. Start the engine and allow it to idle for a few minutes.

CAUTION

Do not run the engine above idle speed until it has built up oil pressure, indicated when the oil light goes out.

12. Shut off the engine, allow the oil to drain for a minute, and check the oil level. Check around the filter and drain plug for any leaks, and correct as necessary.

Manual Transmission

FLUID RECOMMENDATIONS

Pick-Ups and 4Runner – multipurpose gear oil API GL-4 or GL-5; SAE 75W-90 or 80W-90

FLUID LEVEL CHECK

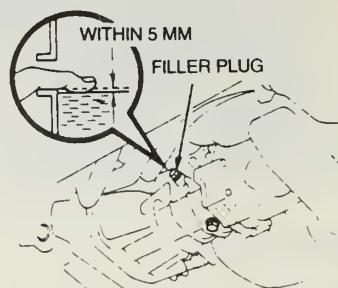
The oil in the manual transmission should be checked at least every 7500 miles (12,000 km) and replaced every 25,000–30,000 miles (40,000–48,000 km), even more frequently if driven in deep water.

1. With the truck parked on a level surface, remove the filler plug (17mm) from the side of the transmission housing.

2. If the lubricant begins to trickle out of the hole, there is enough. Otherwise, carefully insert your finger (watch out for sharp threads) and check to see if the oil is up to the edge of the hole.

3. If not, add oil through the hole until the level is at the edge of the hole. Most gear lubricants come in a plastic squeeze bottle with a nozzle; making additions simple. You can also use a common everyday kitchen baster.

4. Replace the filler plug, run the engine and check for leaks.



The fluid level must be very close to the bottom of the fill hole

DRAIN AND REFILL

Once every 30,000 miles, the oil in the manual transmission should be changed.

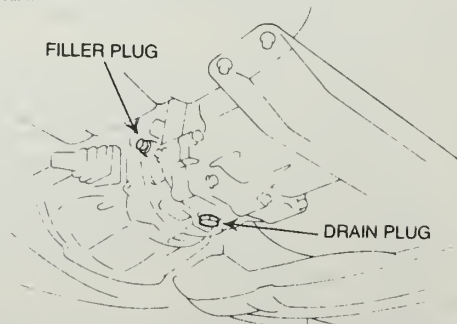
1. The transmission oil should be hot before it is drained. If the engine is at normal operating temperature, the transmission oil should be hot enough.

2. Raise the truck and support it properly on jackstands so that you can safely work underneath. You will probably not have enough room to work if the truck is not raised.

3. The drain plug is located on the bottom of the transmission. It is on the passenger side on four speeds, and on the bottom center of five speeds. Place a pan under the drain plug and remove it. Keep a slight upward pressure on the plug while unscrewing it, this will keep the oil from pouring out until the plug is removed.

CAUTION

The oil will be HOT. Be careful when you remove the plug so that you don't take a bath in hot gear oil.



All manual transmissions have a drain and fill plug

4. Allow the oil to drain completely. Clean off the plug and replace it, tightening it until it is just snug.

5. Remove the filler plug from the side of the transmission

case. It is on the driver's side of four speeds, and on the passenger side on five speeds. There will be a gasket underneath this plug. Replace it every time the bolt is removed.

6. Fill the transmission with gear oil through the filler plug hole.

7. The oil level should come right up to the edge of the hole. You can stick your finger in to verify this. Watch out for sharp threads.

8. Replace the filler plug and gasket, lower the truck, and check for leaks. Dispose of the old oil in the proper manner.

Automatic Transmission FLUID RECOMMENDATIONS

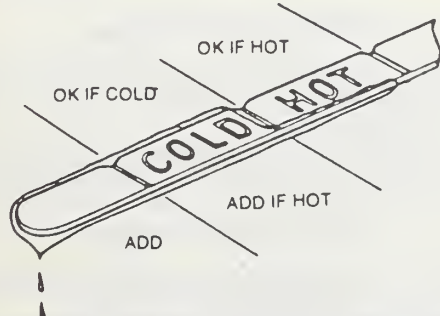
All: ATF DEXRON® II

FLUID LEVEL CHECK

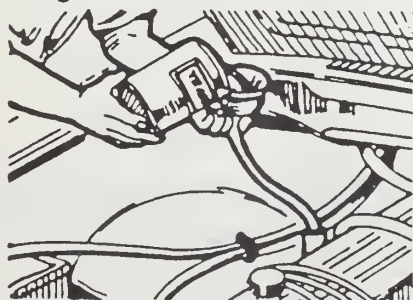
Check the automatic transmission fluid level at least every 15,000 miles (more if possible). The dipstick is in the rear of the engine compartment. The fluid level should be checked only when the transmission is hot (normal operating temperature). The transmission is considered hot after about 20 miles of highway driving.

1. Park the truck on a level surface with the engine idling. Shift the transmission into Neutral or Park and set the parking brake.

2. Remove the dipstick, wipe it clean and reinsert it firmly. Be sure that it has been pushed all the way in. Remove the dipstick and check the fluid level while holding it horizontally. With the engine running, the fluid level should be between the second and third notches on the dipstick.



Automatic transmission dipstick. The fluid level must be checked with the transmission oil warm and the engine running



A funnel with a long, flexible neck allows you to add fluid to the automatic transmission

3. If the fluid level is below the second notch, use only Dexron®II Automatic transmission fluid. This is easily done with the aid of a funnel. Check the level often as you are filling the transmission. Be extremely careful not to overfill it. Overfilling will cause slippage, seal damage and overheating. Approx-

imately one pint of ATF will raise the level from one notch to the other.

The fluid on the dipstick should always be a bright red color. If it is discolored (brown or black), or smells burnt, serious transmission troubles, probably due to overheating, should be suspected. The transmission should be inspected by a qualified service technician to locate the cause of the burnt fluid.

DRAIN AND REFILL

The automatic transmission fluid should be changed at least every 25,000-30,000 miles (40,000-48,000 km). If the truck is normally used in severe service, such as stop-and-go driving, trailer towing or the like, the interval should be halved. The fluid should be hot before it is drained; a 20 minute drive will accomplish this.

Toyota automatic transmissions each have a drain plug in them so that fluid may be drained without removing the pan. The filter within the pan is not replaceable as a maintenance item; removing the pan is not required or recommended during transmission maintenance.

2WD

4WD

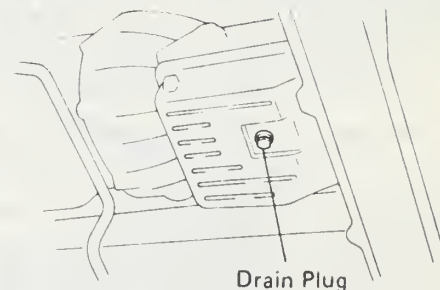


Drain Plug



Drain Plug

Automatic transmission drain plugs on trucks and 4Runners. Note that 4wd vehicles must be drained at 2 locations



Drain Plug

Land Cruiser automatic transmission drain plug

With the truck safely supported on stands, position a large catch pan below the drain plug. Remove the plug slowly and be prepared for a rush of HOT fluid. Allow the unit to drain for some minutes; when the flow of oil is down to individual drops, replace the drain plug and tighten just snug. Add transmission fluid through the dipstick tube under the hood.

Replace the dipstick after filling. Start the engine and allow to idle. DO NOT race the engine. After the engine has idled for a few minutes, shift the transmission slowly through the gears and then return it to Park. With the engine still idling, check the fluid level on the dipstick. If necessary, add more fluid to raise the level.

Transfer Case

FLUID RECOMMENDATIONS

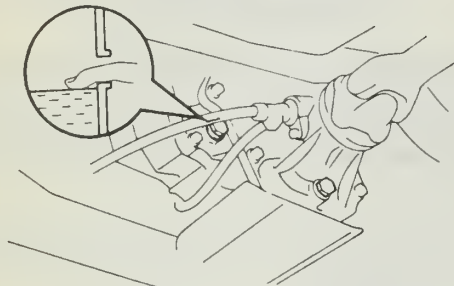
- Pick-Ups and 4Runner w/MT — multipurpose gear oil API GL-4 or GL-5; SAE 75W-90 or 80W-90
- Pick-Ups and 4Runner w/AT — ATF DEXRON®II

1 GENERAL INFORMATION AND MAINTENANCE

• Land Cruiser — multipurpose gear oil API GL-4 or GL-5; SAE 90W.

FLUID LEVEL CHECK

The oil in the transfer case should be checked at least every 7500 miles (12,000 km) and replaced every 25,000–30,000 miles (40,000–48,000 km), even more frequently if driven in deep water.



Land Cruiser transfer case

1. With the truck parked on a level surface, remove the filler plug from the side of the transmission housing.
2. If the lubricant begins to trickle out of the hole, there is enough. Otherwise, carefully insert your finger (watch out for sharp threads) and check to see if the oil is up to the edge of the hole.

CAUTION

Prolonged and repeated skin contact with used engine oil, with no effort to remove the oil, may be harmful. Always follow these simple precautions when handling used motor oil.

3. If not, add oil through the hole until the level is at the edge of the hole. Most gear lubricants come in a plastic squeeze bottle with a nozzle; making additions simple. You can also use a common everyday kitchen baster.
4. Replace the filler plug, run the engine and check for leaks.

DRAIN AND REFILL

1. The transfer case oil should be hot before it is drained. If the engine is at normal operating temperature, the oil should be hot enough.
2. Raise the truck and support it properly on jackstands so that you can safely work underneath.
3. The drain plug is located on the bottom of the transfer case. Place a pan under the drain plug and remove it.

CAUTION

The oil will be HOT. Be careful when you remove the plug so that you don't take a bath in hot gear oil.

4. Allow the oil to drain completely. Clean off the plug and replace it, tightening it until it is just snug.
5. Remove the filler plug from the side of the case.
6. Fill the transfer case with the correct oil through the filler plug hole as detailed previously. Refer to the Capacities Chart for the amount of oil needed to refill your transfer case.
7. The oil level should come right up to the edge of the hole. You can stick your finger in to verify this.
8. Replace the filler plug and gasket, lower the truck, and check for leaks. Dispose of the old oil in the proper manner.

Drive Axles (Differentials)

FLUID RECOMMENDATIONS

All models — Hypoid gear oil API GL-5; below 0°F (–18°C): SAE 90W, above 0°F (–18°C): SAE 80W or 80W-90.

FLUID LEVEL CHECK

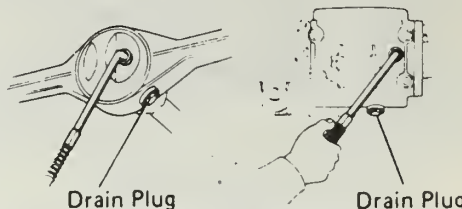
The oil in the front and/or rear differential should be checked at least every 7500 miles (12,000 km).

1. With the truck parked on a level surface, remove the filler plug from the back of the differential.

NOTE: The plug on the bottom is the drain plug.

Differential (Rear)

(Front)



Truck and 4Runner differential drain and fill ports. Land Cruiser similar

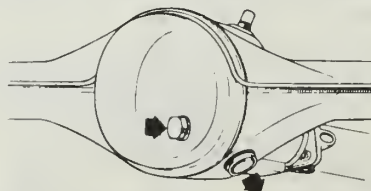
2. If the oil begins to trickle out of the hole, there is enough. Otherwise, carefully insert your finger (watch out for sharp threads) into the hole and check to see if the oil is up to the bottom edge of the filler hole.
3. If not, add oil through the hole until the level is at the edge of the hole. Most gear oils come in a plastic squeeze bottle with a nozzle, making additions simple. Use standard GL-5 hypoid type gear oil; SAE 90 or SAE 80 if you live in a particularly cold area.
4. Replace the filler plug and drive the truck for a short distance. Stop the truck and check for leaks.

DRAIN AND REFILL

The gear oil in the front or rear axle should be changed at least every 25,000–30,000 miles (40,000–48,000 km); immediately if driven in deep water.

To drain and fill the rear axle, proceed as follows:

1. Park the vehicle on a level surface. Set the parking brake.
2. Remove the filler (upper) plug. Place a container which is large enough to catch all of the differential oil under the drain plug.
3. Remove the drain (lower) plug and gasket, if so equipped. Allow all of the oil to drain into the container.
4. Install the drain plug. Tighten it so that it will not leak, but do not overtighten.



Drain and fill locations for differentials

5. Refill with the proper grade and viscosity of axle lubricant. Be sure that the level reaches the bottom of the filler plug. DO NOT overfill.
6. Install the filler plug and check for leakage.

Cooling System

FLUID RECOMMENDATIONS

When additional coolant is required to maintain the proper level, always add a 50/50 mixture of ethylene glycol antifreeze/coolant and water. The use of supplementary inhibi-

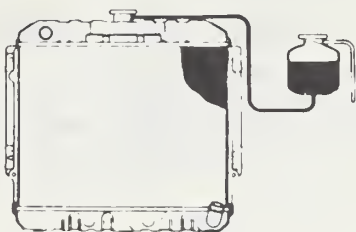
tors or additives is neither required nor recommended.

FLUID LEVEL CHECK

Dealing with the cooling system can be a tricky matter unless the proper precautions are observed. All vehicles use a coolant reservoir tank (expansion tank) connected to the radiator by a small hose. Look through the plastic tank; the fluid level should be between FULL and LOW lines. Note that the FULL line is below the very top of the tank, allowing room for expansion. If the level in the tank is low, remove the top of the tank and add coolant to the FULL line.

Never remove the radiator cap to check fluid level; there is a high risk of scalding from escaping hot fluid. It's a good idea to check the coolant every time that you stop for fuel. If the coolant level is low, add equal amount of ethylene glycol based antifreeze.

Avoid using water that is known to have a high alkaline content or is very hard, except in emergency situations. Drain and flush the cooling system as soon as possible after using such water.



Always check the level in the reservoir tank, not in the radiator

The radiator hoses and clamps and the radiator cap should be checked at the same time as the coolant level. Hoses which are brittle, cracked, or swollen should be replaced. Clamps should be checked for tightness (screwdriver tight only.) Do not allow the clamp to cut into the hose or crush the fitting. The radiator cap gasket should be checked for any obvious tears, cracks or swelling, or any signs of incorrect seating in the radiator neck.

DRAIN AND REFILL

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage. Coolant should be reused unless it is contaminated or several years old.

Completely draining and refilling the cooling system every two years at least will remove accumulated rust, scale and other deposits.

1. Make certain the engine is cold. Generally, this means at least 3 hours from last operation, longer in hot weather. Overnight cold is best.

2. Remove the radiator cap. Drain the existing antifreeze and coolant. Open the radiator and engine drain petcocks, or disconnect the bottom radiator hose at the radiator outlet. Set the heater temperature controls to the full HOT position.

NOTE: Before opening the radiator petcock, spray it with some penetrating lubricant.

3. Close the petcocks or reconnect the lower hose and fill the system with the correct mixture of antifreeze and water in the correct amount. It will take a bit of time for the level to stabilize within the radiator.

4. Double check the drain cocks for closure. Install the radiator cap.

5. Flush the reservoir with water, empty it and install coolant mixture to the FULL line.

6. Start the engine, allowing it to idle. As it warms up, keep a close watch on the drain cocks and/or hose fittings used to drain the system. If any leakage is seen, shut the engine off and deal with the leak.

7. After the engine has warmed up, shut the engine off. Check the level in the reservoir tank and adjust the fluid level as needed.

NOTE: Fresh antifreeze has a detergent quality. Fluid in the reservoir may appear muddy or discolored due to the cleaning action of the new coolant. If the system has been neglected for a period of time, it may be necessary to redrain the system to eliminate this sludge.

Check the Radiator Cap

While you are replacing the coolant, check the radiator cap for a worn or cracked gasket. If the cap doesn't seal properly, fluid will be lost and the engine will overheat.

A worn cap should be replaced with a new one.

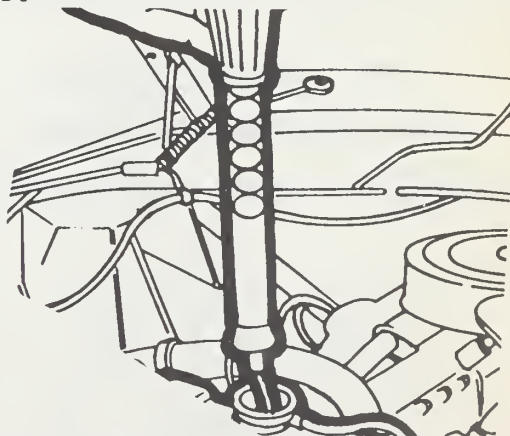
Clean Radiator of Debris

Periodically clean any debris such as leaves, paper, insects, etc., from the radiator fins. Pick the large pieces off by hand. The smaller pieces can be washed away with water pressure from a hose.

Carefully straighten any bent radiator fins with a pair of needle nose pliers. Be careful, the fins are very soft. Don't wiggle the fins back and forth too much. Straighten them once and try not to move them again.

CHECKING SYSTEM PROTECTION

A 50/50 mix of coolant concentrate and water will usually provide protection to -35°F (-37°C). Freeze protection may be checked by using a cooling system hydrometer. Inexpensive hydrometers may be obtained from a local auto supply store. Follow the directions packaged with the coolant hydrometer when checking protection.



A coolant checker (hydrometer) will show the boiling and freezing point of the coolant

Master Cylinders

All models have the brake master cylinder reservoir on the left side of the firewall under the hood. Trucks and 4Runners with manual transmissions use a hydraulic (fluid actuated) clutch. The clutch fluid reservoir is located in the same area as brake reservoir. The clutch master cylinder uses the same fluid as the brakes, and should be checked at the same time as the brake master cylinder.

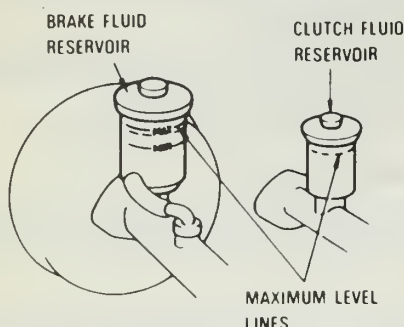
1 GENERAL INFORMATION AND MAINTENANCE

FLUID RECOMMENDATIONS

Use only Heavy Duty Brake fluid meeting DOT 3 or SAE J1703 specifications.

FLUID LEVEL CHECK

The fluid in the brake and/or clutch master cylinders should be checked every 6 months or 6,000 miles (9,600 km). Check the fluid level at the side of the reservoir. If fluid is required, thoroughly wipe the top of the reservoir and the sides of the plastic housing with a rag before opening. The fluid must be kept free from dirt and grit. Fill the reservoir to the MAX line in the reservoir. Never overfill the reservoir. Install the reservoir cap, making sure the gasket is properly seated in the cap.



Fluid reservoirs for brake and clutch systems

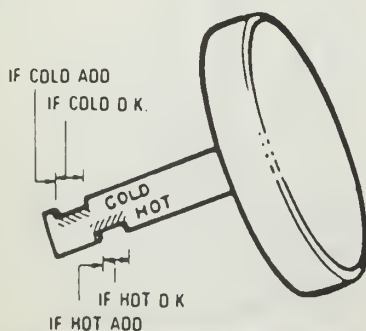
WARNING: Brake fluid damages painted surfaces. If any fluid is spilled, immediately clean it off with plenty of clean water. It also absorbs moisture from the air; never leave a container of fluid or the master cylinder or the clutch cylinder uncovered any longer than necessary.

It is normal for the fluid level to fall as the disc brake pads wear. However, if the master cylinder requires filling frequently, you should check the system for leaks in the hoses, master cylinder, or wheel cylinders.

Power Steering Pump

FLUID RECOMMENDATIONS

Use only DEXRON®II automatic transmission fluid in the power steering system.



Checking the power steering fluid level. Note that the different levels for cold and hot fluid

FLUID LEVEL CHECK

Check the power steering fluid level every 6 months or 6,000 miles (9,600 km).

1. Park the vehicle on a level surface. Run the engine until normal operating temperature is reached.

2. Turn the steering all the way to the left and then all the way to the right several times. Center the steering wheel and shut off the engine.

3. Open the hood and check the power steering reservoir fluid level.

4. Remove the filler cap on the power steering fluid reservoir and wipe the dipstick clean.

5. Re-insert the dipstick and tighten the cap. Remove the dipstick and note the fluid level indicated on the dipstick.

6. The level should be at any point below the Full mark, but not below the Add mark (in the HOT or COLD ranges).

7. Add fluid as necessary. Do not overfill.

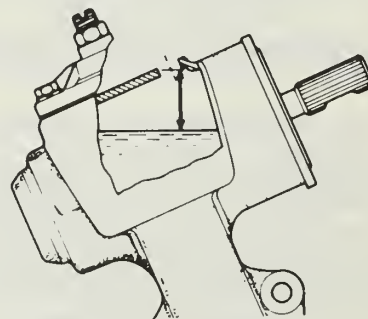
Steering Gear

FLUID RECOMMENDATIONS

Use standard hypoid-type gear oil GL-4, SAE 90W when re-filling the steering gear.

FLUID LEVEL CHECK

Every year or 15,000 miles (24,000 km) you should check the steering gear housing lubricating oil. The filler plug is on top of the housing and requires a 14mm wrench for removal. The level should be $\frac{3}{4}$ –1 inch (18–28mm) from the top on 2WD models and $\frac{9}{16}$ – $\frac{11}{16}$ inch (14–17mm) from the top on 4WD models.



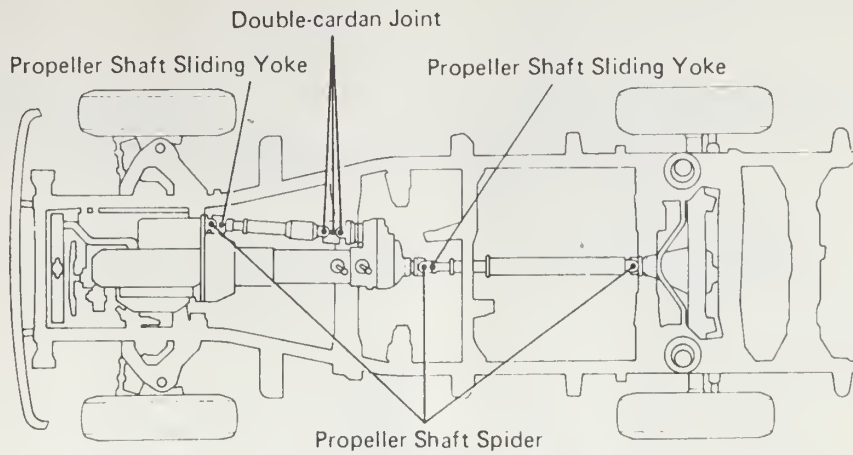
With the fill plug removed, measure the distance from the fluid to the top of the steering gearbox

Chassis Greasing

Complete chassis greasing should include an inspection of all rubber suspension bushings, lubrication of all body hinges, as well as proper greasing of the front suspension upper and lower ball joints and control arm bushings. To provide correct operation, the chassis should be greased every with every oil and filter change or 7500 miles.

If you wish to perform this operation yourself, purchase a cartridge type grease gun and several cartridges of multipurpose lithium grease. Push the nozzle of the grease gun down firmly onto the fitting and while applying pressure, force the new grease into the fitting. Force sufficient grease into the fitting to cause some old grease to be expelled. Use an old rag to wipe off expelled grease; keep the fittings and joints free of globs of grease.

Four wheel drive vehicles have several lubrication points within the driveshaft and driveline. Some of these fittings are tucked into hard to see places; make certain each one is accounted for. Additionally, 1989–90 Land Cruisers have lube fittings at the ends of the relay rods in the steering system. 1991 Land Cruisers use permanently sealed joints; no lubrication is necessary.



M/T (W56, R150F) and A/T

M/T (G58)



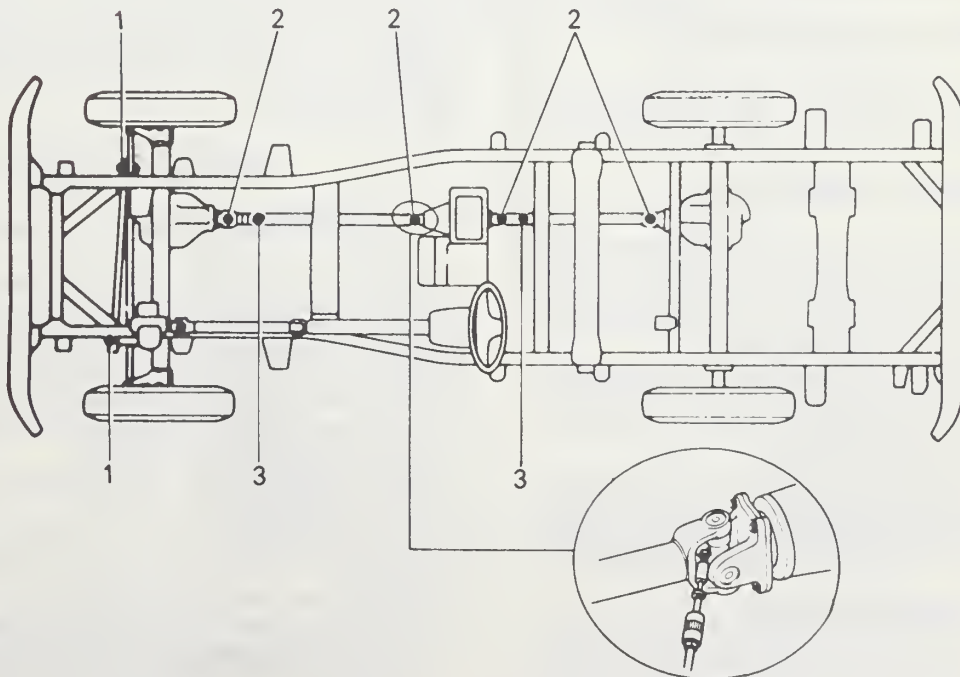
Spider



Double-cardan Joint

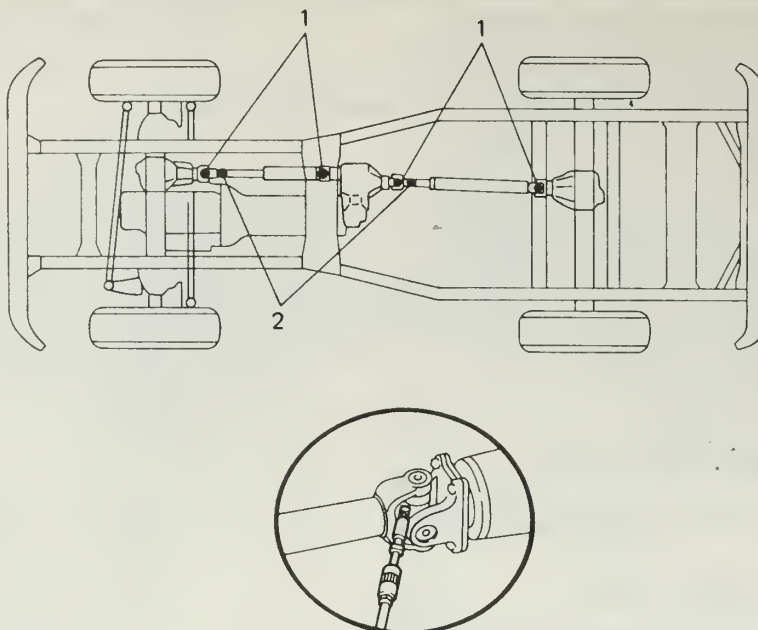


Lubrication points — 4wd truck and 4Runner



Lubrication points — 1989-90 Land Cruiser

1 GENERAL INFORMATION AND MAINTENANCE



Lubrication points — 1991 Land Cruiser

MANUAL TRANSMISSION AND CLUTCH LINKAGE

On models so equipped, apply a small amount of chassis grease to the pivot points of the transmission and clutch linkage.

AUTOMATIC TRANSMISSION LINKAGE

On models so equipped, apply a small amount of 10W engine oil to the kickdown and shift linkage at the pivot points.

PARKING BRAKE LINKAGE

At yearly intervals or whenever binding is noticeable in the parking brake linkage, lubricate the cable guides, levers and linkage with a suitable chassis grease.

GENERAL LUBRICATION

Door handles, hinges, and locks should be lubricated at least once a year. Use a light lithium grease for hinges and handles. Use spray graphite for door locks. Do not inject oil into door locks; it attracts and holds dirt and grit, causing binding and stiff operation, particularly in cold weather.

Additionally, a small amount of grease should be applied to the hood and trunk latches and hinges periodically. Other moving components such as seat back pivots or cargo compartments should be attended to on as-needed basis.

NOTE: When performing lubrication of any item in the passenger area (doors, locks, etc.) apply lubricant sparingly and thoroughly wipe up the excess to prevent lubricant getting onto upholstery and/or clothing.

EXTERIOR CARE

Keep the exterior of the vehicle clean. Dirt can cause small scratches in the paint and the chemicals in road dirt and air pollution can cause paint damage. Frequent washing is recommended; this is particularly important for vehicles used in snowy areas, near salt water or any vehicle used off the road.

Wash the vehicle in the shade when the body is not hot to the touch. Wash with mild car-wash soap and rinse thoroughly before the soap dries on the paint. It may be necessary to wash and rinse the vehicle in sections to prevent the soap from streaking the paint. Never use gasoline or strong solvents to clean painted surfaces.

Use a chamois or soft, lint-free rag to dry the exterior. Wring the drying rag out frequently and keep it away from areas in which it may pick up dirt or grit. If the rag or chamois is dropped on the ground, rinse it thoroughly before continuing; it may carry grit which will scratch the finish.

After the paint is completely dry, the bodywork may be waxed with any of the commercial car polishes or waxes. Read the can carefully before purchase; use good judgment in deciding the condition of the finish. A wax for older finishes will have more abrasive to remove oxidized paint. A "new car" wax will have much less abrasive.

Wheel Bearings

ADJUSTMENT AND LUBRICATION

Only the front wheel bearings require periodic service. The lubricant to use is high temperature disc brake wheel bearing grease meeting NLGI No. 2 specifications. This service is recommended at 30,000 miles on trucks, 4Runners and 1991 Land Cruisers. On 1989-90 Land Cruisers, the interval is 26,500 miles. In either case, if the mileage is not achieved, the bearings should be packed every 36 months or whenever the truck has been driven in water up to the hub.

Before handling the bearings there are a few things that you should remember:
Observe the following:

1. Remove all outside dirt from the housing before exposing the bearing.
2. Treat a used bearing as gently as you would a new one.
3. Work with clean tools in clean surroundings.
4. Use clean, dry canvas gloves, or at least clean, dry hands.
5. Clean solvents and flushing fluids are a must.
6. Use clean paper when laying out the bearings to dry.
7. Protect disassembled bearings from rust and dirt. Cover them up.
8. Use clean rags to wipe bearings

GENERAL INFORMATION AND MAINTENANCE 1

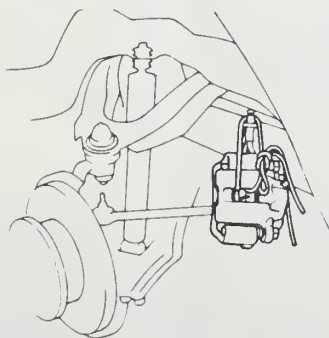
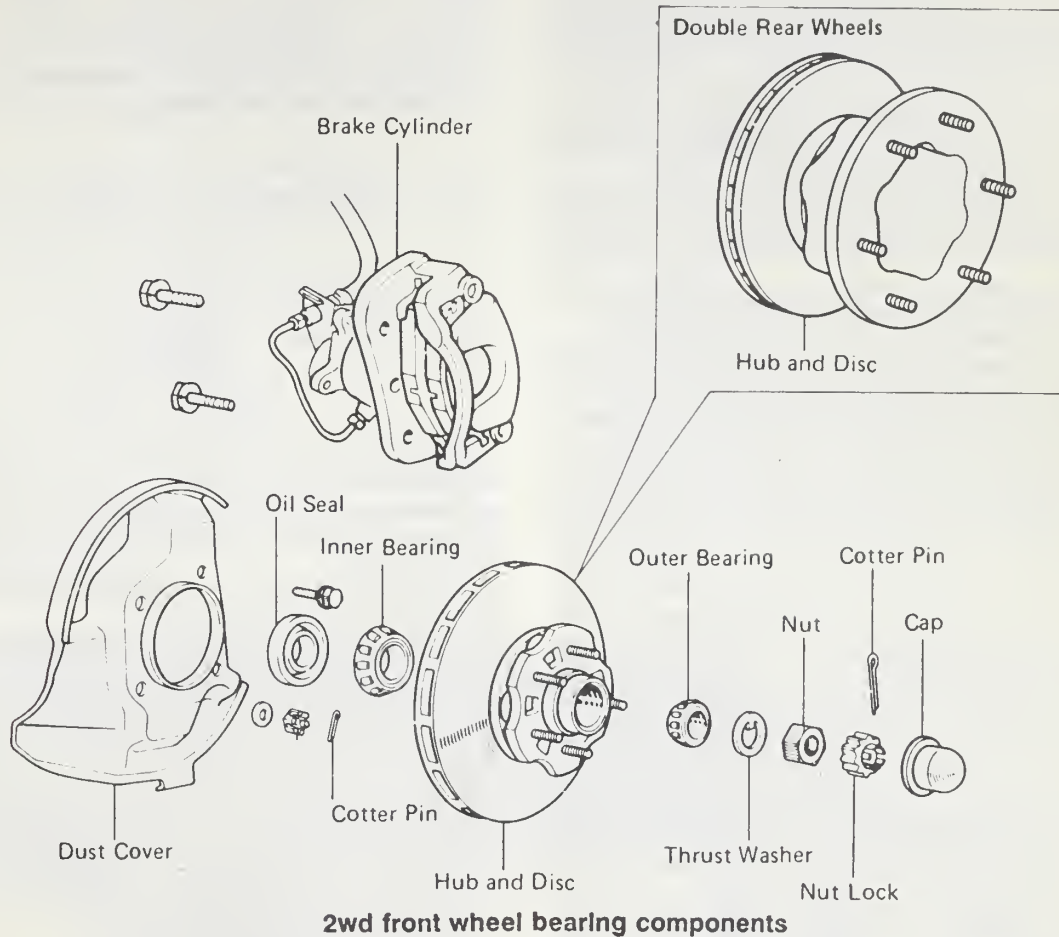
9. Keep the bearings in oil-proof paper when they are to be stored or are not in use.

10. Clean the inside of the housing before replacing the bearings.

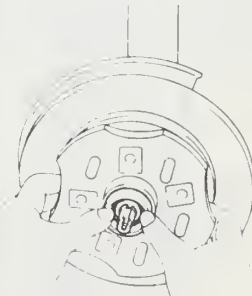
Do NOT do the following:

1. Don't work in dirty surroundings.
2. Don't use dirty, chipped, or damaged tools.
3. Try not to work on wooden work benches or use wooden mallets.

4. Don't handle bearings with dirty or moist hands.
5. Do not use gasoline for cleaning; use a safe solvent.
6. Do not spin dry bearings with compressed air. They will be damaged.
7. Do not spin unclean bearings.
8. Avoid using cotton waste or dirty cloths to wipe bearings.
9. Do not scratch or nick bearing surfaces.
10. Do not allow the bearing to come in contact with dirt or rust at any time.



Hang the caliper out of harm's way



Use thumbs to keep the bearing from falling out during removal and installation

1 GENERAL INFORMATION AND MAINTENANCE

2-Wheel Drive

1. Elevate and safely support the front of the truck on jackstands.
2. Remove the wheel.
3. Remove the brake caliper from its mount. Use stiff wire to suspend it out of the way; do not loosen the brake hose at the caliper. Remove the brake pads.

CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

5. Remove the grease cap. Remove the cotter pin and lock nut. Use a socket of the correct size to loosen and remove the axle nut.

6. Remove the hub and brake disc together with the outer bearing and thrust washer. Use your thumbs to keep the pieces inside the hub as the unit is removed. Be careful not to drop the outer bearing.

7. Use a small prying tool to remove the inner bearing seal. Once the seal is out, remove the bearing from the hub.

8. Place all both bearings and all the nuts, caps, etc., into a wide container of cleaning solvent. Cleanliness is essential to wheel bearing maintenance. Use a soft bristle brush to clean every bit of grease from every component. Place each cleaned component on a clean, lint-free cloth and allow them to air dry.

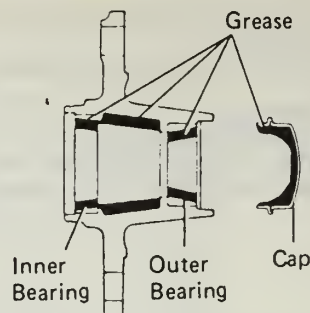
9. Inspect the bearings for pitting, flat spots, rust, and rough areas. Check the races (inner surfaces of the hub) for the same conditions. If any damage is seen, the components must be replaced. As a general rule, if either a bearing or race is damaged, the matching part that contacts it should also be replaced. Replacement bearings, seals and other required parts can be bought at an auto parts store. The old parts that are to be replaced should be taken along to be compared with the replacement part to insure a perfect match.

10. Pack the wheel bearings with grease. There are special devices made for the specific purpose of greasing bearings, but if one is not available, pack the wheel bearings by hand. Put a large dab of grease in the palm of your hand and push the bearing through it with a sliding motion. The grease must be forced through the side of the bearing and in between each roller. Continue until the grease begins to ooze out the other side and through the gaps between the rollers; the bearing must be completely packed with grease.

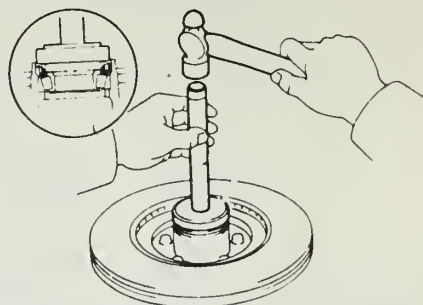
11. Coat the inside of the hub and cap with grease, but do not pack it solid. Remember that the spindle ("axle") has to pass through the center.

12. Clean the spindle thoroughly and inspect it for any sign of damage. Coat it with a very light layer of bearing grease.

13. Install the inner bearing into the race. Use a seal driver of the correct diameter to install a NEW grease seal over the bear-



Areas to be cleaned and re-greased during front wheel bearing maintenance



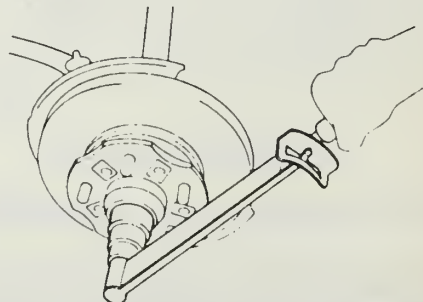
Always use a bearing driver; other instruments may cause damage

ing. Reusing the old seal may cost more money than it saves; if the grease leaks out and the bearing fails, the wheel may seize while in motion.

14. Place the hub and disc onto the spindle. Install the outer bearing and the flat thrust washer.

15. Install the lock nut and use a torque wrench to adjust the nut to 34 Nm (25 ft. lbs).

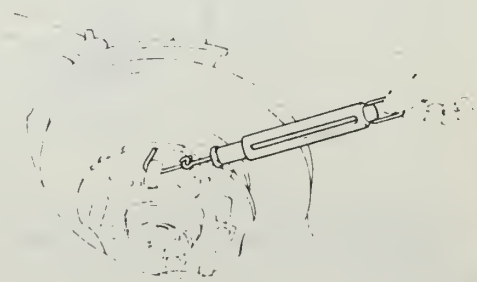
16. Turn the hub in each direction several times to seat and snug the bearing. Loosen the lock nut until it can be turned by



Use a torque wrench to pre-load the bearing after installation



Packing bearings by hand is messy but effective. Make sure grease is forced into every part



The simple spring scale is essential in setting the final bearing adjustment

JUMP STARTING A DEAD BATTERY

The chemical reaction in a battery produces explosive hydrogen gas. This is the safe way to jump start a dead battery, reducing the chances of an accidental spark that could cause an explosion.

Jump Starting Precautions

1. Be sure both batteries are of the same voltage.
2. Be sure both batteries are of the same polarity (have the same grounded terminal).
3. Be sure the vehicles are not touching.
4. Be sure the vent cap holes are not obstructed.
5. Do not smoke or allow sparks around the battery.
6. In cold weather, check for frozen electrolyte in the battery. Do not jump start a frozen battery.
7. Do not allow electrolyte on your skin or clothing.
8. Be sure the electrolyte is not frozen.

CAUTION: Make certain that the ignition key, in the vehicle with the dead battery, is in the OFF position. Connecting cables to vehicles with on-board computers will result in computer destruction if the key is not in the OFF position.

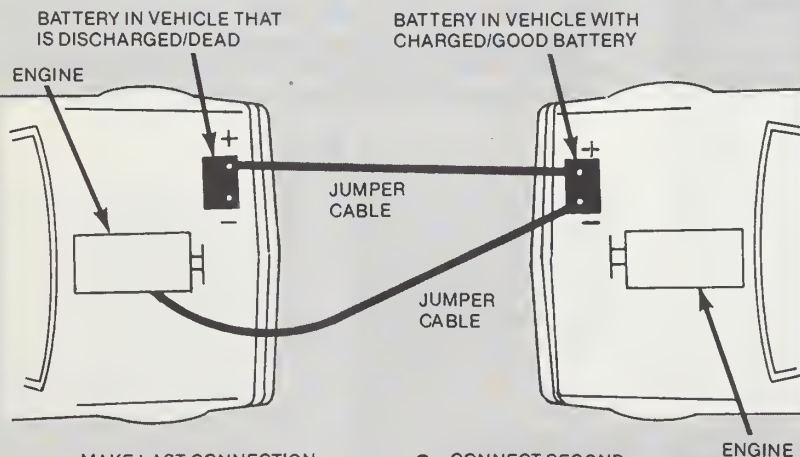
Jump Starting Procedure

1. Determine voltages of the two batteries; they must be the same.
2. Bring the starting vehicle close (they must not touch) so that the batteries can be reached easily.
3. Turn off all accessories and both engines. Put both vehicles in Neutral or Park and set the handbrake.
4. Cover the cell caps with a rag—do not cover terminals.
5. If the terminals on the run-down battery are heavily corroded, clean them.
6. Identify the positive and negative posts on both batteries and connect the cables in the order shown.
7. Start the engine of the starting vehicle and run it at fast idle. Try to start the car with the dead battery. Crank it for no more than 10 seconds at a time and let it cool for 20 seconds in between tries.
8. If it doesn't start in 3 tries, there is something else wrong.
9. Disconnect the cables in the reverse order.
10. Replace the cell covers and dispose of the rags.

MAKE CERTAIN VEHICLES DO NOT TOUCH

- 1 CONNECT JUMPER CABLE TO DEAD BATTERY (+ TERMINAL)

- 2 CONNECT OTHER + END OF JUMPER CABLE TO GOOD BATTERY (+ TERMINAL)

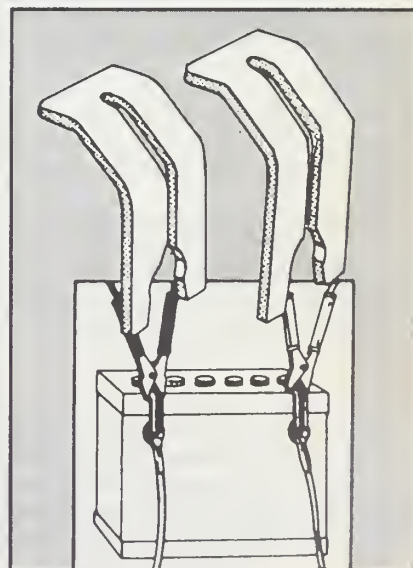


- 4 MAKE LAST CONNECTION OF SECOND JUMPER CABLE (-) TO ENGINE IN CAR WITH DEAD BATTERY; MAKE CONNECTION AWAY FROM BATTERY.

- 3 CONNECT SECOND JUMPER CABLE TO GOOD BATTERY (- TERMINAL)

FOR NEGATIVE GROUND VEHICLES

Side terminal batteries occasionally pose a problem when connecting jumper cables. There frequently isn't enough room to clamp the cables without touching sheet metal. Side terminal adaptors are available to alleviate this problem and should be removed after use.



1 GENERAL INFORMATION AND MAINTENANCE

hand without the wrench. Don't loosen it any more than necessary to be finger loose. (Loosening the nut takes the pre-tension off the bearing.)

17. Use a spring tension scale to measure the force needed to turn the hub. Record the number.

18. Tighten the nut until the force required to turn the hub is:

- For single rear wheel vehicles: 0.6–1.8 kg (1.3–4.0 lbs.)
- For dual rear wheel vehicles: 0.4–1.0 kg (0.9–2.2 lbs.)

19. Install the lock nut, cotter pin and grease cap. Make certain the cap is not crooked or loose.

20. Install the brake pads and caliper.

21. Install the wheel. Lower the vehicle to the ground.

4-Wheel Drive

Front wheel bearings on 4WD vehicles are covered in Section 7. Do not attempt to disassemble the bearings and hubs on these vehicles without referring to the appropriate procedures.

PUSHING AND TOWING

WARNING: Push-starting is not recommended. All trucks are equipped with a catalytic converter. Raw gas collecting in the converter may cause damage. Additionally, computer controlled fuel injection system components may be damaged. Jump starting from a known good battery is the only recommended method of starting a disabled vehicle.

If Toyota truck needs to be towed, the best way is to use a flatbed or rollback tow vehicle which can carry the vehicle with all 4 wheels off the ground.

Trucks and 4Runners may also be towed with either end elevated. To tow with rear wheels on the ground, release the parking brake and put the transmission in NEUTRAL. The transfer case (if 4WD) must be in H2. The H4 button must be off. With automatic transmissions, the rear drive shaft must be disconnected at the differential if towing will exceed 30 mph or a total of 50 miles. Failure to disconnect the driveshaft will damage the transmission.

Towing trucks and 4Runners with the front wheels on the ground requires the ignition key to be in the ACC position to release the steering lock. On 4WD units, put the transmission in NEUTRAL and the transfer case selector in H2. Disengage the free-wheeling hubs if so equipped. To tow with the front wheels on the ground, the steering wheel must be held in place with special equipment commonly carried on tow trucks. The anti-theft lock is not strong enough to hold the front wheels straight during towing.

Land Cruisers may be towed in similar manners but in all cases the center differential switch must be OFF and the center differential set in the FREE position.

All vehicles are equipped with tow hooks front and rear which may be used for flat towing with a rope or chain. A driver must be in the vehicle to steer it and operate the brakes. Towing in this manner must only be done for a short distance at low speeds. The entire drive line, wheels, axles, etc., must be in serviceable condition. The transmission must be in NEUTRAL and, on 4WD models, the transfer case in H2. On Land Cruisers, switch the center differential lock OFF.

TRAILER TOWING

Factory trailer towing packages are available on most Toyota trucks. However, if you are installing a trailer hitch and wiring on your truck, there are a few things that you ought to know.

Trailer Weight

Trailer weight is the first, and most important, factor in determining whether or not your vehicle is suitable for towing the

trailer you have in mind. Each vehicle has a maximum trailer weight (trailer plus load) which must not be exceeded. Additionally, each vehicle has a gross combination weight which is the maximum allowable load under any condition. Gross combination weight is the sum of the trailer, the trailer load, the tow vehicle and the vehicle load including passengers. Consult the owner's manual or your dealer for the specific numbers for your vehicle.

Hitch Weight

There are three kinds of hitches: bumper mounted, frame mounted, and load equalizing.

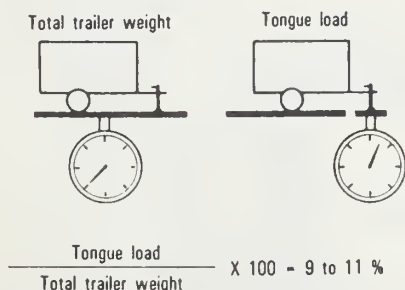
Bumper mounted hitches are those which attach solely to the vehicle's bumper. Many states prohibit towing with this type of hitch, when it attaches to the vehicle's stock bumper, since it subjects the bumper to stresses for which it was not designed. Aftermarket rear step bumpers, designed for trailer towing, are acceptable for use with bumper mounted hitches.

Frame mounted hitches can be of the type which bolts to two or more points on the frame, plus the bumper, or just to several points on the frame. Frame mounted hitches can also be of the tongue type, for Class I towing, or, of the receiver type, for Classes II and III.

Toyota does not recommend the installation of a weight distributing or load equalizing hitch.

Check the gross weight rating of your trailer. Tongue weight is usually figured as 10% of gross trailer weight. Therefore, a trailer with a maximum gross weight of 2000 lb. will have a maximum tongue weight of 200 lb. Class I trailers fall into this category. Class II trailers are those with a gross weight rating of 2000–3500 lb., while Class III trailers fall into the 3500–6000 lb. category. Class IV trailers are those over 6000 lb. and are for use with fifth wheel trucks, only.

When you've determined the hitch that you'll need, follow the manufacturer's installation instructions, exactly, especially when it comes to fastener torques. The hitch will be subjected to a lot of stress and good hitches come with hardened bolts. Never substitute an inferior bolt for a hardened bolt.



Trailer tongue weight must be approximately 10% of the total trailer weight

Wiring

Wiring your Toyota for towing is fairly easy. There are a number of good wiring kits available and these should be used, rather than trying to design your own. All trailers will need brake lights and turn signals as well as tail lights and side marker lights. Most states require extra marker lights for overly wide trailers. Also, most states have recently required back-up lights for trailers, and most trailer manufacturers have been building trailers with back-up lights for several years.

Additionally, some Class I, most Class II and just about all Class III trailers will have electric brakes.

Add to this number an accessories wire, to operate trailer internal equipment or to charge the trailer's battery, and you can have as many as seven wires in the harness.

Determine the equipment on your trailer and buy the wiring kit necessary. The kit will contain all the wires needed, plus a plug adapter set which included the female plug, mounted on the bumper or hitch, and the male plug, wired into, or plugged into the trailer harness.

When installing the kit, follow the manufacturer's instructions. The color coding of the wires is standard throughout the industry.

One point to note, most imported vehicles, have separate turn signals. On most domestic vehicles, the brake lights and rear turn signals operate with the same bulb. For those vehicles with separate turn signals, you can purchase an isolation unit so that the brake lights won't blink whenever the turn signals are operated, or, you can go to your local electronics supply house and buy four diodes to wire in series with the brake and turn signal bulbs. Diodes will isolate the brake and turn signals. The choice is yours. The isolation units are simple and quick to install, but far more expensive than the diodes. The diodes, however, require more work to install properly, since they require the cutting of each bulb's wire and soldering in place of the diode.

One final point, the best kits are those with a spring loaded cover on the vehicle mounted socket. This cover prevents dirt and moisture from corroding the terminals. Never let the vehicle socket hang loosely. Always mount it securely to the bumper or hitch.

Oil Coolers

Aftermarket engine oil coolers are helpful for prolonging engine oil life and reducing overall engine temperatures. Both of these factors increase engine life.

While not absolutely necessary in towing Class I and some Class II trailers, they are recommended for heavier Class II and all Class III towing.

Engine oil cooler systems consist of an adapter, screwed on in place of the oil filter, a remote filter mounting and a multi-tube, finned heat exchanger, which is mounted in front of the radiator or air conditioning condenser.

TRANSMISSION

An automatic transmission is usually recommended for trailer towing. Modern automatics have proven reliable and, of course, easy to operate, in trailer towing.

The increased load of a trailer, however, causes an increase in the temperature of the automatic transmission fluid. Heat is the worst enemy of an automatic transmission. As the temperature of the fluid increases, the life of the fluid decreases.

It is essential, therefore, that you install an automatic transmission cooler. Such coolers are usually part of a trailer towing package installed by a dealer or manufacturer.

The cooler, which consists of a multi-tube, finned heat exchanger, is usually installed in front of the radiator or air conditioning condenser, and hooked in line with the transmission cooler tank inlet line. Follow the cooler manufacturer's installation instructions.

Select a cooler of at least adequate capacity, based upon the combined gross weights of the truck and trailer.

Cooler manufacturers recommend that you use an aftermarket cooler in addition to, and not instead of, the present cooling tank in your radiator. If you do want to use it in place of the radiator cooling tank, get a cooler at least two sizes larger than normally necessary.

NOTE: A transmission cooler can, sometimes, cause slow or harsh shifting in the transmission during cold weather, until the fluid has a chance to come up to normal operating temperature. Some coolers can be purchased with or retrofitted with a temperature bypass valve which will allow fluid flow through the cooler only when the fluid has reached operating temperature, or above.

1 GENERAL INFORMATION AND MAINTENANCE

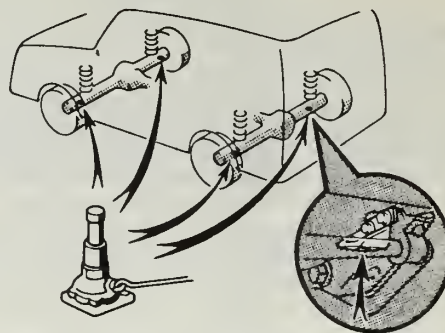
JACKING

Your truck is equipped with an axle or a bottle-type jack. Learn where the jack is and how it works before it is needed. This jack is for emergency use only and should not be used for routine maintenance.

On 1989-90 Land Cruisers, the jack points are under the front axle housing between the leaf spring and the stabilizer bar. Rear points are under the rear axle near the wheel to be changed. On 1991 Land Cruisers, the points are the same except for the right rear, which is under the bracket on the rear axle housing.

On 4Runners, the jack points are under the front suspension crossmember and under the rear axle housing. On 2WD trucks, locate the jack either under the frame siderails at the front or under the rear axle housing. For 4WD trucks, jack the front at the front suspension crossmember instead of the frame.

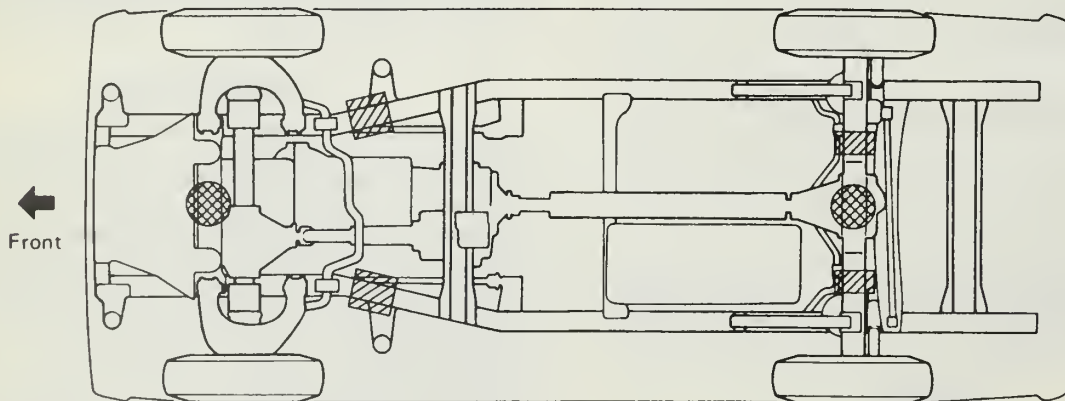
When raising the truck with a jack, follow these precautions: Park the truck on level spot, put the selector in PARK with an automatic transmission or in reverse if your truck has a manual transmission. Apply the parking brake and block the front and the back of the wheel that is diagonally opposite the wheel being changed. These jacks are fine for changing a tire, but never crawl under the truck when it is supported only by the jack.



Jacking points on 1991 Land Cruiser

CAUTION

If you're going to work beneath the vehicle, always support it on jackstands.



JACK

Front Center of crossmember
Rear Center of rear axle housing

SUPPORT

Safety stand

Jacking points for the 4Runner

GENERAL INFORMATION AND MAINTENANCE

1

MAINTENANCE SCHEDULE A 1989-90 Truck

Maintenance operations: A = Check and adjust if necessary;
R = Replace, change or lubricate;
I = Inspect and correct or replace if necessary

- Towing a trailer, using a camper or car top carrier.
- Repeat short trips less than 5 miles (8 km) and outside temperatures remain below freezing.
- Extensive idling and/or low speed driving for a long distance such as police, taxi or door-to-door delivery use.
- Operating on dusty, rough, muddy or salt spread roads.

System	Service interval (Odometer reading or months, whichever comes first)		Maintenance services beyond 60,000 miles (96,000 km) should be performed at the same intervals shown in each maintenance schedule.																	
			Miles × 1,000	5	7.5	10	15	20	22.5	25	30	35	37.5	40	45	50	52.5	55	60	
	Maintenance items		Km × 1,000	8	12	16	24	32	36	40	48	56	60	64	72	80	84	88	96	
			Months	6	9	12	18	24	27	30	36	42	45	48	54	60	63	66	72	
ENGINE	Timing belt	3VZ-E engine	R ⁽¹⁾																	
	Valve clearance*	22R, 22R-E engine									A								A	
	Valve clearance	3VZ-E engine																	A	
	Drive belts ⁽²⁾										I								I	
	Engine oil and oil filter*		R			R	R	R		R	R	R			R	R	R		R	R
	Engine coolant ⁽³⁾																			R
	Exhaust pipes and mountings						I					I				I				
FUEL	Idle speed	22R-E, 3VZ-E engine ⁽⁴⁾			A						A								A	
	Idle speed and fast idle speed	22R engine ⁽⁵⁾									A									
	Air filter* ⁽⁹⁾		I			I	I	I		I	R	I			I	I	I		I	R
	Fuel lines and connections											I								I
	Fuel tank cap gasket																		R	
IGNITION	Spark plugs**										R								R	
EVAP	Charcoal canister	Calif. only																	I	
EXHAUST	Oxygen sensor*	Fed. and Canada 22R-E, 3VZ-E engine only	R ⁽⁶⁾																	
BRAKES	Brake linings and drums		4WD		I		I		I		I		I		I		I		I	
			2WD			I		I				I		I		I		I		I
	Brake pads and discs		4WD		I		I		I		I		I		I		I		I	
			2WD			I		I				I		I		I		I		I
	Brake line pipes and hoses		4WD				I					I				I				I
			2WD			I		I							I					I
CHASSIS	Steering linkage ⁽¹⁰⁾		4WD		I		I		I		I		I		I		I		I	
			2WD			I		I				I		I		I		I		I
	Ball joints and dust covers		4WD		I		I		I		I		I		I		I		I	
			2WD			I		I				I		I		I		I		I
	Drive shaft boots		4WD		I		I		I		I		I		I		I		I	
	Automatic transmission, manual transmission, transfer (4WD), differential and steering gear housing oil ⁽⁷⁾		4WD				R				R				R				R	
			2WD					R							R					R
	Front wheel bearing and thrust bush grease (4WD only)		4WD								R									R
			2WD												R					
	Propeller shaft grease ⁽⁸⁾		4WD		R		R		R		R		R		R		R		R	R
	Bolts and nuts on chassis and body ⁽⁹⁾		4WD		I		I		I		I		I		I		I		I	I
			2WD			I		I				I		I		I		I		

*: For vehicles sold in California

*: For vehicles sold outside California

(1) For the vehicles frequently idled for extensive periods and/or driven for long distances at low speeds such as taxis, police cars and door-to-door delivery vehicles, it is recommended to replace at 60,000 miles (96,000 km).

(2) After 60,000 miles (96,000 km) or 72 months, inspect every 10,000 miles (16,000 km) or 12 months.

(3) After 60,000 miles (96,000 km) or 72 months, replace every 30,000 miles (48,000 km) or 36 months.

(4) After 60,000 miles (96,000 km) or 72 months, adjust every 30,000 miles (48,000 km) or 36 months.

(5) Adjustment at 30,000 miles (48,000 km) or 36 months only.

(6) Replace at 80,000 miles (129,000 km) only.

(7) Inspect the steering gear housing for oil leakage only.

(8) If the propeller shaft has been immersed in water, it should be re-greased daily.

(9) Applicable when operating mainly on dusty roads. If not, follow the schedule B.

(10) Applicable when operating mainly on rough and/or muddy roads. If not, follow the schedule B.

1 GENERAL INFORMATION AND MAINTENANCE

MAINTENANCE SCHEDULE B 1989-90 Truck

Conditions other than those listed for SCHEDULE A.

System	Service interval (Odometer reading or months, whichever comes first)	Maintenance services beyond 60,000 miles (96,000 km) should be performed at the same intervals shown in each maintenance schedule.									
		Miles × 1,000	10	15	20	30	40	45	50	60	
	Maintenance items	Km × 1,000	16	24	32	48	64	72	80	96	
		Months	12	18	24	36	48	54	60	72	
ENGINE	Valve clearance *	22R, 22R-E engine				A				A	
	Valve clearance	3VZ-E engine								A	
	Drive belts ⁽¹⁾					I				I	
	Engine oil and oil filter *		R		R	R	R		R	R	
	Engine coolant ⁽²⁾									R	
	Exhaust pipes and mountings					I				I	
FUEL	Idle speed	22R-E, 3VZ-E engine ⁽³⁾	A			A				A	
	Idle speed and fast idle speed	22R engine ⁽⁴⁾				A					
	Air filter *					R				R	
	Fuel lines and connections					I				I	
	Fuel tank cap gasket									R	
IGNITION	Spark plugs **					R				R	
EVAP	Charcoal canister	Calif. only								I	
EXHAUST	Oxygen sensor ⁽⁵⁾ *	Fed. and Canada 22R-E, 3VZ-E engine only	R (5)								
BRAKES	Brake linings and drums	4WD		I		I		I		I	
		2WD			I		I			I	
	Brake pads and discs	4WD		I		I		I		I	
		2WD			I		I			I	
	Brake line pipes and hoses	4WD		I		I		I		I	
		2WD			I		I			I	
CHASSIS	Steering linkage	4WD		I		I		I		I	
		2WD			I		I			I	
	Ball joints and dust covers	4WD		I		I		I		I	
		2WD			I		I			I	
	Drive shaft boots	4WD		I		I		I		I	
		2WD			I		I			I	
	Automatic transmission, manual transmission, transfer (4WD), differential and steering gear housing oil ⁽⁶⁾	4WD		I		I		I		I	
		2WD			I		I			I	
	Front wheel bearing and thrust bush grease (4WD only)	4WD				R				R	
		2WD					R				
	Propeller shaft grease ⁽⁷⁾	4WD		R		R		R		R	
		2WD		I		I		I		I	
Bolts and nuts on chassis and body ⁽⁸⁾	4WD			I		I			I		
	2WD			I		I			I		

* For vehicles sold in California

** For vehicles sold outside California

(1) After 60,000 miles (96,000 km) or 72 months, inspect every 10,000 miles (16,000 km) or 12 months.

(2) After 60,000 miles (96,000 km) or 72 months, replace every 30,000 miles (48,000 km) or 36 months.

(3) After 60,000 miles (96,000 km) or 72 months, adjust every 30,000 miles (48,000 km) or 36 months.

(4) Adjustment at 30,000 miles (48,000 km) or 36 months only.

(5) Replace at 80,000 miles (129,000 km) only.

(6) Inspect the steering gear housing for oil leakage only.

(7) If the propeller shaft has been immersed in water, it should be re-greased daily.

GENERAL INFORMATION AND MAINTENANCE

1

MAINTENANCE SCHEDULE A 1989-90 4 Runner Condition

Maintenance operation: A = Check and adjust if necessary;
R = Replace, change or lubricate;
I = Inspect and correct or replace if necessary

- Towing a trailer, using a camper or car top carrier.
- Repeat short trips less than 5 miles (8 km) and outside temperatures remain below freezing.
- Extensive idling and/or low speed driving for a long distance such as police, taxi or door-to-door delivery use.
- Operating on dusty, rough, muddy or seat spread roads.

System	Service interval (Odometer reading or months, whichever comes first)		Maintenance services beyond 60,000 miles (96,000 km) should be performed at the same intervals shown in each maintenance schedule.																		
			Miles × 1,000	1	3.75	7.5	11.25	15	18.75	22.5	26.25	30	33.75	37.5	41.25	45	48.75	52.5	56.25	60	Months
	Maintenance items	km × 1,000	1.6	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96		
ENGINE	Timing belt (1)		3VZ-E engine																R	—	
	Valve clearance*		22R-E engine									A							A	A: Every 36 months	
	Valve clearance		3VZ-E engine																A	A: Every 72 months	
	Drive belts		I: First period. 30,000 miles (48,000 km) or 36 months, 60,000 miles (96,000 km) or 72 months I: After that every 7,500 miles (12,000 km) or 12 months																		
	Engine oil and oil filter*			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R: Every 6 months
	Engine coolant		R: First period. 45,000 miles (72,000 km) or 36 months R: After that every 30,000 miles (48,000 km) or 24 months																		
	Exhaust pipes and mountings						I				I				I				I	I	I: Every 24 months
FUEL	Idle speed		A: First period. 7,500 miles (12,000 km) or 12 months, 30,000 miles (48,000 km) or 36 months R: After that every 30,000 miles (48,000 km) or 36 months																		
	Air filter* (2)			I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I: Every 6 months R: Every 36 months	
	Fuel lines and connections (3)										I								I	I: Every 36 months	
	Fuel tank cap gasket																		R	R: Every 72 months	
IGNITION	Spark plugs**										R								R	R: Every 36 months	
EVAP	Charcoal canister	Calif. only																	I	I: Every 72 months	
EXHAUST	Oxygen sensor	Fed. and Canada only	R: 80,000 miles (129,000 km) only																		
BRAKES	Brake linings and drums				I		I		I		I		I		I		I		I	I: Every 12 months	
	Brake pads and discs				I		I		I		I		I		I		I		I	I: Every 12 months	
	Brake line pipes and hoses						I				I				I				I	I: Every 24 months	
CHASSIS	Steering linkage				I		I		I		I		I		I		I		I	I: Every 12 months	
	Ball joints and dust covers				I		I		I		I		I		I		I		I	I: Every 12 months	
	Drive shaft boots	4WD			I		I		I		I		I		I		I		I	I: Every 12 months	
	Automatic transmission, manual transmission, transfer (4WD) and differential							R				R			R				R	I: Every 24 months	
	Steering gear housing oil (4)						I				I				I				I	I: Every 24 months	
	Front wheel gearing and thrust bush grease		2WD								R								R	R: Every 48 months	
			4WD								R								R	R: Every 36 months	
	Propeller shaft grease (5)		4WD			R		R		R		R		R		R		R	R: Every 12 months		
	Bolts and nuts on chassis and body (6)					I		I		I		I		I		I		I	I	I: Every 12 months	

*: California specification vehicles.

*: Vehicles other than California specification vehicles.

- (1) Applicable to vehicles operated under conditions of extensive idling and/or low speed driving for long distances such as police, taxi or door-to-door delivery use.
- (2) Applicable when operating mainly on dusty roads.
- (3) Includes inspection of vapor vent system.
- (4) Check for oil leaks from steering gear box.
- (5) If the propeller shaft has been immersed in water, it should be re-greased daily.
- (6) Applicable only when operating mainly on rough, muddy roads. The applicable parts are listed below. For other usage conditions, refer to SCHEDULE B.
 - Front and rear suspension member cross body.

GENERAL INFORMATION AND MAINTENANCE

MAINTENANCE SCHEDULE B 1989-90 4 Runner

Conditions other than those listed for SCHEDULE A.

System	Service interval (Use odometer reading or months, whichever comes first)	Maintenance services beyond 60,000 miles (96,000 km) should continue to be performed at the same intervals shown for each maintenance schedule.										
		Miles × 1,000	1	7.5	15	22.5	30	37.5	45	52.5	60	Months
		km × 1,000	1.6	12	24	36	48	60	72	84	96	
ENGINE	Valve clearance*	22R-E engine					A				A	A: Every 36 months
	Valve clearance	3VZ-E engine									A	A: Every 72 months
	Drive belts	I: First period. 30,000 miles (48,000 km) or 36 months, 60,000 miles (96,000 km) or 72 months I: After that every 7,500 miles (12,000 km) or 12 months										
	Engine oil and oil filter*		R	R	R	R	R	R	R	R	R	R: Every 12 months
	Engine coolant	R: First period. 45,000 miles (72,000 km) or 36 months R: After that every 30,000 miles (48,000 km) or 24 months										
	Exhaust pipes and mountings			I			I		I		I	I: Every 24 months
FUEL	Idle speed	A: First period. 7,500 miles (12,000 km) or 12 months, 30,000 miles (48,000 km) or 36 months A: After that every 30,000 miles (48,000 km) or 36 months										
	Air filter*						R				R	R: Every 36 months
	Fuel lines and connections (1)						I				I	I: Every 36 months
	Fuel tank cap gasket										R	R: Every 72 months
IGNITION	Spark plugs**						R				R	R: Every 36 months
EVAP	Charcoal canister	Calif. only									I	I: Every 72 months
EXHAUST	Oxygen sensor	Fed. and Canada only	R: 80,000 miles (129,000 km) only									
BRAKES	Brake linings and drums				I		I		I		I	I: Every 24 months
	Brake pads and discs				I		I		I		I	I: Every 24 months
	Brake line pipes and hoses				I		I		I		I	I: Every 24 months
CHASSIS	Steering linkage				I		I		I		I	I: Every 24 months
	Ball joints and dust covers				I		I		I		I	I: Every 24 months
	Drive shaft boots	4WD			I		I		I		I	I: Every 24 months
	Automatic transmission, manual transmission, transfer (4WD) and differential (2)				I		I		I		I	I: Every 24 months
	Steering gear housing oil (3)				I		I		I		I	I: Every 24 months
	Front wheel bearing and thrust bush grease (4WD)	2WD					R				R	R: Every 48 months
		4WD					R				R	R: Every 36 months
	Propeller shaft grease (4)	4WD			R		R		R		R	R: Every 24 months
	Bolts and nuts on chassis and body (5)				I		I		I		I	I: Every 24 months

*: California specification vehicles.

*: Vehicles other than California specification vehicles.

(1) Includes inspection of vapor vent system.

(2) Check for oil level.

(3) Check for oil leaks from steering gear box.

(4) If the propeller shaft has been immersed in water, it should be re-greased daily.

(5) Applicable only when operating mainly on rough, muddy roads. The applicable parts are listed below. For other usage conditions, refer to SCHEDULE B.

- Front and rear suspension member cross body.
- Bolts for sheet installation.

GENERAL INFORMATION AND MAINTENANCE 1

MAINTENANCE SCHEDULE A & B 1989-90 Land Cruiser

Maintenance operations: A = Check and adjust if necessary;
R = Replace, change or lubricate;
I = Inspect and correct or replace if necessary

Conditions:

- Towing a trailer, using a camper or car top carrier.
- Repeated short trips of less than 5 miles (8 km) with outside temperatures remain below freezing.
- Extensive idling and/or low speed driving for long distances such as police, taxi or door-to-door delivery use.
- Operating on dusty, rough, muddy or salt spread roads.

System	Service interval (Odometer reading or months, whichever comes first)	Maintenance services beyond 60,000 miles (96,000 km) should continue to be performed at the same intervals shown in each maintenance schedule.																		
		Miles × 1,000	3.75	7.5	11.25	15	18.75	22.5	26.25	30	33.75	37.5	41.25	45	48.75	52.5	56.25	60	Months	
	Maintenance items	km × 1,000	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96		
ENGINE	Valve clearance*					A				A				A				A	A: Every 24 months	
	Drive belts ⁽¹⁾									I								I	I: 36 months; 72 months	
	Engine oil and oil filter*		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R: Every 6 months	
	Engine coolant ⁽²⁾													R					R: 36 months	
	Exhaust pipes and mountings					I				I				I				I	I: Every 24 months	
FUEL	Air filter* ⁽³⁾		I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I: Every 6 months; R: Every 36 months	
	Fuel lines and connections ⁽⁴⁾									I								I	I: Every 36 months	
	Fuel tank cap gasket																	R	R: Every 72 months	
IGNITION	Spark plug**									R								R	R: Every 36 months	
EVAP	Charcoal canister	Calif. only																I	I: Every 72 months	
EXHAUST	Oxygen sensor*	Except California	R: 80,000 miles (128,000 km) only																	
BRAKES	Brake linings and drums ⁽⁵⁾			I		I		I		I		I		I		I		I	I: Every 12 months	
	Brake pads and discs			I		I		I		I		I		I		I		I	I: Every 12 months	
	Brake line pipes and hoses					I				I				I				I	I: Every 24 months	
CHASSIS	Steering linkage			I		I		I		I		I		I		I		I	I: Every 12 months	
	Ball joints and dust covers			I		I		I		I		I		I		I		I	I: Every 12 months	
	Automatic transmission					R				R				R				R	I: Every 24 months	
	Transfer, differential and steering gear box oil ⁽⁶⁾					I				I				I				I	I: Every 24 months	
	Front wheel bearing and thrust bush grease									R								R	R: Every 36 months	
	Steering knuckle and chassis grease ⁽⁷⁾			R		R		R		R		R		R		R		R	R: Every 12 months	
	Propeller shaft grease ⁽⁷⁾			R		R		R		R		R		R		R		R	R: Every 12 months	
	Bolts and nuts on chassis and body ⁽⁸⁾			I		I		I		I		I		I		I		I	I: Every 12 months	

*: For vehicle sold in California

*: For vehicle sold outside California

(1) After 60,000 miles (96,000 km) or 72 months, inspect every 7,500 miles (12,000 km) or 12 months.

(2) After 45,000 miles (72,000 km) or 36 months, replace every 30,000 miles (48,000 km) or 24 months.

(3) Applicable when operating mainly on dusty roads. If not, follow schedule B.

(4) Includes inspection of fuel tank band and vapor vent system.

(5) Also applicable to lining drum for parking brake.

(6) Inspect the steering gear box for oil leakage only.

(7) If the propeller shaft has been immersed in water, it should be re-greased within a day.

(8) Applicable only when operating mainly on rough, muddy roads. The applicable parts are listed below. For other usage conditions, refer to SCHEDULE B.

- Front and rear suspension member cross body.
- Strut bar bracket cross body
- U bolts for leaf spring.
- Bolts for sheet installation.

1 GENERAL INFORMATION AND MAINTENANCE

SCHEDULE B

Maintenance operations: A = Check and adjust if necessary;
R = Replace, change or lubricate;
I = Inspect and correct or replace if necessary

Conditions: Conditions other than those listed for SCHEDULE A.

System	Service interval (Odometer reading or months, whichever comes first)	Maintenance services beyond 60,000 miles (96,000 km) should be performed at the same intervals shown in each maintenance schedule.									
		Miles × 1,000	7.5	15	22.5	30	37.5	45	52.5	60	Months
	Maintenance Items	km × 1,000	12	24	36	48	60	72	84	96	
ENGINE	Valve clearance*			A		A		A		A	A: Every 24 months
	Drive belts ⁽¹⁾					I				I	I: 36 months, 72 months
	Engine oil and oil filter*		R	R	R	R	R	R	R	R	R: Every 12 months
	Engine coolant ⁽²⁾							R			R: Every 36 months
	Exhaust pipes and mountings					I				I	I: Every 36 months
FUEL	Air filter*					R				R	R: Every 36 months
	Fuel lines and connections ⁽³⁾					I				I	I: Every 36 months
	Fuel tank cap gasket									R	R: Every 72 months
IGNITION	Spark plug**					R				R	R: Every 36 months
EVAP	Charcoal canister	California only								I	I: Every 72 months
EXHAUST	Oxygen sensor*	Except California	R: 80,000 miles (128,000 km) only								
BRAKES	Brake linings and drums ⁽⁴⁾			I		I		I		I	I: Every 24 months
	Brake pads discs (Front and rear)			I		I		I		I	I: Every 24 months
	Brake line pipes and hoses			I		I		I		I	I: Every 24 months
CHASSIS	Steering linkage			I		I		I		I	I: Every 24 months
	Ball joints and dust covers			I		I		I		I	I: Every 24 months
	Front wheel bearing and thrust bush grease					R				R	R: Every 24 months
	Steering knuckle and chassis grease ⁽⁵⁾			R		R		R		R	R: Every 24 months
	Propeller shaft grease ⁽⁵⁾			R		R		R		R	R: Every 24 months
	Automatic transmission			I		I		I		I	I: Every 24 months
	Transfer, differential and steering gear box oil ⁽⁶⁾			I		I		I		I	I: Every 24 months
	Bolts and nuts on chassis and body ⁽⁷⁾			I		I		I		I	I: Every 24 months

*: For vehicle sold in California

*: For vehicle sold outside California

(1) After 60,000 miles (96,000 km) or 72 months, inspect every 7,500 miles (12,000 km) or 12 months.

(2) After 45,000 miles (72,000 km) or 36 months, replace every 30,000 miles (48,000 km) or 24 months.

(3) Includes inspection of fuel tank band vapor vent system.

(4) Also applicable to lining drum for parking brake.

(5) If the propeller shaft has been immersed in water, it should be re-greased within a day.

(6) Inspect the steering gear box for oil leakage only.

(7) The applicable parts are listed below.

- Front and rear suspension member cross body.
- Strut bar bracket cross body
- U bolts for leaf spring.
- Bolts for sheet installation.

GENERAL INFORMATION AND MAINTENANCE 1

MAINTENANCE SCHEDULE A 1991 Land Cruiser

Maintenance operations: A = Check and adjust if necessary;
R = Replace, change or lubricate;
I = Inspect and correct or replace if necessary

Conditions:

- Towing a trailer, using a camper or car top carrier.
- Repeat short trips less than 5 miles (8 km) and outside temperatures remain below freezing.
- Extensive idling and/or low speed driving for long distances, such as police, taxi or door-to-door delivery use.
- Operating on dusty, rough, muddy or salt spread roads.

System	Service interval (Odometer reading or months, whichever comes first)	Maintenance services beyond 60,000 miles (96,000 km) should continue to be performed at the same intervals shown in each maintenance schedule.																		
		Miles × 1,000	3.75	7.5	11.25	15	18.75	22.5	26.25	30	33.75	37.5	41.25	45	48.75	52.5	56.25	60	Months	
	Maintenance items	km × 1,000	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96		
ENGINE	Valve clearance*					A				A				A				A	A: Every 24 months	
	Drive belts ⁽¹⁾									I								I	I: 36 months; 72 months	
	Engine oil and oil filter *		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R: Every 6 months	
	Engine coolant ⁽²⁾													R					R: 36 months	
	Exhaust pipes and mountings					I				I				I				I	I: Every 24 months	
FUEL	Air filter * ⁽³⁾		I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I: Every 6 months; R: Every 36 months	
	Fuel lines and connections ⁽⁴⁾									I								I	I: Every 36 months	
	Fuel tank cap gasket																	R	R: Every 72 months	
IGNITION	Spark plugs* *									R								R	R: Every 36 months	
EVAP	Charcoal canister	Calif. only																I	I: Every 72 months	
EXHAUST	Oxygen sensor*	Except California	R: 80,000 miles (128,000 km) only																	
BRAKES	Brake linings and drums ⁽⁵⁾			I		I		I		I		I		I		I		I	I: Every 12 months	
	Brake pads and discs			I		I		I		I		I		I		I		I	I: Every 12 months	
	Brake line pipes and hoses					I				I				I				I	I: Every 24 months	
CHASSIS	Steering linkage			I		I		I		I		I		I		I		I	I: Every 12 months	
	Ball joints and dust covers			I		I		I		I		I		I		I		I	I: Every 12 months	
	Automatic transmission					R				R				R				R	I: Every 24 months	
	Transfer and differential					R				R				R				R	R: Every 24 months	
	Steering gear box oil ⁽⁶⁾					I				I				I				I	I: Every 24 months	
	Front wheel bearing and thrust bush grease									R								R	R: Every 36 months	
	Steering knuckle and chassis grease ⁽⁷⁾			R		R		R		R		R		R		R		R	R: Every 12 months	
	Propeller shaft grease ⁽⁷⁾			R		R		R		R		R		R		R		R	R: Every 12 months	
	Bolts and nuts on chassis and body ⁽⁸⁾			I		I		I		I		I		I		I		I	I: Every 12 months	

*: For vehicle sold in California

*: For vehicle sold outside California

(1) After 60,000 miles (96,000 km) or 72 months, inspect every 7,500 miles (12,000 km) or 12 months.

(2) After 45,000 miles (72,000 km) or 36 months, replace every 30,000 miles (48,000 km) or 24 months.

(3) Applicable when operating mainly on dusty roads. If not, follow schedule B.

(4) Includes inspection of fuel tank band and vapor vent system.

(5) Also applicable to lining drum for parking brake.

(6) Inspect the steering gear box for oil leakage only.

(7) If the propeller shaft has been immersed in water, it should be re-greased within a day.

(8) Applicable only when operating mainly on rough, muddy roads. The applicable parts are listed below. For other usage conditions, refer to SCHEDULE B.

- Bolts for sheet installation

1 GENERAL INFORMATION AND MAINTENANCE

SCHEDULE B

Conditions: Conditions other than those listed for SCHEDULE A.

System	Service interval (Odometer reading or months, whichever comes first)	Maintenance services beyond 60,000 miles (96,000 km) should be performed at the same intervals shown in each maintenance schedule.									
	Maintenance items	Miles × 1,000	7.5	15	22.5	30	37.5	45	52.5	60	Months
		km × 1,000	12	24	36	48	60	72	84	96	
ENGINE	Valve clearance*			A		A		A		A	A: Every 24 months
	Drive belts ⁽¹⁾					I				I	I: 36 months, 72 months
	Engine oil and oil filter*		R	R	R	R	R	R	R	R	R: Every 12 months
	Engine coolant ⁽²⁾							R			R: Every 36 months
	Exhaust pipes and mountings					I				I	I: Every 36 months
FUEL	Air filter*					R				R	R: Every 36 months
	Fuel lines and connections ⁽³⁾					I				I	I: Every 36 months
	Fuel tank cap gasket									R	R: Every 72 months
IGNITION	Spark plugs**					R				R	R: Every 36 months
EVAP	Charcoal canister	California only				*				I	I: Every 72 months
EXHAUST	Oxygen sensor*	Except California	R: 80,000 miles (129,000 km) only								
BRAKES	Brake linings and drums ⁽⁴⁾			I		I		I		I	I: Every 24 months
	Brake pads discs (Front and rear)			I		I		I		I	I: Every 24 months
	Brake line pipes and hoses			I		I		I		I	I: Every 24 months
CHASSIS	Steering linkage			I		I		I		I	I: Every 24 months
	Ball joints and dust covers			I		I		I		I	I: Every 24 months
	Front wheel bearing and thrust bush grease					R				R	R: Every 24 months
	Steering knuckle and chassis grease ⁽⁵⁾			R		R		R		R	R: Every 24 months
	Propeller shaft grease ⁽⁵⁾			R		R		R		R	R: Every 24 months
	Automatic transmission			I		I		I		I	I: Every 24 months
	Transfer, differential and steering gear box oil ⁽⁶⁾			I		I		I		I	I: Every 24 months
	Bolts and nuts on chassis and body ⁽⁷⁾			I		I		I		I	I: Every 24 months

*: For vehicle sold in California

*: For vehicle sold outside California

(1) After 60,000 miles (96,000 km) or 72 months, inspect every 7,500 miles (12,000 km) or 12 months.

(2) After 45,000 miles (72,000 km) or 36 months, replace every 30,000 miles (48,000 km) or 24 months.

(3) Includes inspection of fuel tank band vapor vent system.

(4) Also applicable to lining drum for parking brake.

(5) If the propeller shaft has been immersed in water, it should be re-greased within a day.

(6) Inspect the steering gear box for oil leakage only.

CAPACITIES CHART

Years	Models	Engine	Crankcase Includes Filter (qt.)	Drain & Refill Transmission (qts.)			Drive Axle (qts.)		Fuel Tank (gal.)	Cooling System (qt.)	
				4-sp	5-sp	Auto.	Front	Rear		Man.	Auto.
1989	2WD Truck	22R	4.5	2.5	2.3	2.5	—	1.4	13.7 ^①	8.9	9.6
		22R-E	4.5	—	2.5	2.5	—	1.4	17.2 ^②	8.9	9.6
		3VZ-E	4.5	—	3.2	1.7	—	1.9		11.0	10.8
	4WD Truck	22R-E	4.5	—	4.1	1.7	2.0 ^④	2.3	17.2 ^①	8.9	9.6
		3VZ-E	4.5	—	3.2	4.8	1.7	2.5	19.3 ^②	11.0	10.8
1990	2WD Truck	22R	4.5	2.5	2.3	2.5	—	1.4	13.7 ^①	8.9	9.6
		22R-E	4.5	—	2.5	2.5	—	1.4	17.2 ^②	8.9	9.6
		3VZ-E	4.5	—	3.2	1.7	—	1.9		11.0	10.8
	4WD Truck	22R-E	4.5	—	4.1 ^③	1.7	2.0 ^④	2.3	17.2 ^①	8.9	9.6
		3VZ-E	4.5	—	3.2	4.8	1.7	2.5	19.3 ^②	11.0	10.8
1991	2WD Truck	22R-E	4.5	—	2.5	2.5	—	1.4	13.7 ^①	8.9	9.6
		3VZ-E	4.5	—	3.2	1.7	—	1.9	17.2 ^②	11.0	10.8
	4WD Truck	22R-E	4.5	—	4.1 ^③	1.7	2.0 ^④	2.3	17.2 ^①	8.9	9.6
		3VZ-E	4.5	—	3.2	4.8	1.7		19.3 ^②	11.1	10.9
1989	Land Cruiser	3F-E	8.2	—		6.3	3.2	2.6	23.8	—	20.6
1990	Land Cruiser	3F-E	8.2	—		6.3	3.2	2.6	23.8	—	20.6
1991	Land Cruiser	3F-E	8.2	—		6.3	3.0	3.4	25.1	—	19.5
1989	4-Runner	22R-E	4.5		4.1 ^⑥	2.5 ^⑨	20.4 ^④	2.3	17.2	8.9	9.6
					3.2 ^⑦	1.7 ^⑩				9.2 ^⑤	9.9 ^⑤
					2.5 ^⑧						
1990	4-Runner	22R-E	4.5		4.1 ^⑥	2.5 ^⑨	20.4 ^④	2.3	17.2	8.9	9.6
					3.2 ^⑦	1.7 ^⑩				9.2 ^⑤	9.9 ^⑤
					2.5 ^⑧						
1991	4-Runner	22R-E	4.5		4.1 ^⑥	2.5 ^⑨	20.4 ^④	1.9 ^⑨	17.2	8.9	9.6
					3.2 ^⑦	1.7 ^⑩				9.2 ^⑤	9.9 ^⑤
					2.5 ^⑧						
		3VZ-E	4.8		3.2	1.7 ^⑨	1.7			11.1	10.9
						4.8 ^⑩					

① Short wheel base

② Others

③ RN101L-TRL5EA & RN110L-CRL5EA only

④ With A.D.D.

⑤ With rear heater

⑥ RN130L-GJL5EA, RN130L-GKL5EA, RN131L-RJL5EK & RN131L-RKL5EK

⑦ RN130L-GJM5EA, RN130L-GKM5EA, RN131L-RJM5EK & RN131L-RKM5EK

⑧ RN121L-RKM5EK

⑨ 2WD

⑩ 4WD

1 GENERAL INFORMATION AND MAINTENANCE

TRANSFER CASE CAPACITIES

Year	4-Runner	Qts.	Year	Truck	Qts.	Year	Land Cruiser	Qts.
1989	Manual Trans		1989	Manual Trans		1989	Automatic	2.2
	with A.D.D.	1.2		with A.D.D.	1.2			
	without A.D.D.	1.7		without A.D.D.	1.7			
	22R-E Eng., Auto. Trans.	1.2		22 R-E Eng., Auto. Trans.	1.2			
	3VZ-E Eng., Auto. Trans.	0.8 ^①		3VZ-E Eng., Auto. Trans.	0.8 ^①			
1990	Manual Trans		1990	Manual Trans		1990	Automatic	2.2
	with A.D.D.	1.2		with A.D.D.	1.2			
	without A.D.D.	1.7		without A.D.D.	1.7			
	22R-E Eng., Auto. Trans.	1.2		22 R-E Eng., Auto. Trans.	1.2			
	3VZ-E Eng., Auto. Trans.	0.8 ^①		3VZ-E Eng., Auto. Trans.	0.8 ^①			
1991	Manual Trans		1991	Manual Trans		1991	Automatic	2.2
	with A.D.D.	1.2		with A.D.D.	1.2			
	without A.D.D.	1.7		without A.D.D.	1.7			
	22R-E Eng., Auto. Trans.	1.2		22 R-E Eng., Auto. Trans.	1.2			
	3VZ-E Eng., Auto. Trans.	0.8 ^①		3VZ-E Eng., Auto. Trans.	0.8 ^①			

^① Drain & Refill; dry fill = 1.2Q

TORQUE SPECIFICATIONS

Component	English	Metric
Fuel filter inlet line nut:	22 ft. lbs.	29 Nm
Fuel delivery pipe union bolt:	22 ft. lbs.	29 Nm
Cooling system hose clamps:	30-34 inch lbs.	3.4-3.8 Nm

2

Engine Performance and Tune-Up

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2 ENGINE PERFORMANCE AND TUNE-UP

TUNE-UP PROCEDURES

In order to extract the best performance and economy from your engine it is essential that it be properly tuned at regular intervals. Although computerized engine controls and more durable components have reduced ignition maintenance, a regular tune-up will keep your Toyota's engine running smoothly and will prevent the annoying minor breakdowns and poor performance associated with an untuned engine.

Federal law now requires that manufacturers certify that their vehicle's spark plugs will meet emission rules for 30,000 miles. The maintenance schedules reflect this, showing a mandatory replacement at this mileage. This is a minimum specification; for many vehicles, 30,000 miles is too long. Plan on at least checking spark plugs and other ignition components at least once per year. Check them anytime a deterioration of engine performance is noted. Replaceable tune-up components are relatively inexpensive compared to the inconveniences of a poorly running truck or one that will not start.

This inspection interval should be halved if the truck is operated under severe conditions, such as trailer towing, prolonged idling, continual stop and start driving, or if starting or running problems are noticed. It is assumed that the routine maintenance described in Chapter 1 has been kept up, as this will have a profound effect on the results of a tune-up. All of the applicable steps of a tune-up should be followed in order, as the result is a cumulative one.

If the specifications on the tune-up sticker in the engine compartment of your Toyota disagree with the "Tune-Up Specifications" chart in this chapter, the figures on the sticker must be used. The sticker often reflects changes made during the production run.

They are a good indicator of the condition of the engine. A small deposit of light tan or gray material (or rusty red with unleaded fuel) on a spark plug that has been used for any period of time is to be considered normal. Any other color, or abnormal amounts of deposit, indicates that there is something amiss in the engine.

The gap between the center electrode and the side or ground electrode can be expected to increase very slightly (km) under normal conditions.

When a spark plug is functioning normally or, more accurately, when the plug is installed in an engine that is functioning properly, the plugs can be taken out, cleaned, regapped, and reinstalled in the engine without doing the engine any harm.

When, and if, a plug fouls and begins to misfire, you will have to investigate, correct the cause of the fouling, and either clean or replace the plug. Replacement is always recommended if possible.

Spark plugs suitable for use in your Toyota's engine are offered in a number of different heat ranges. The amount of heat which the plug absorbs is determined by the length of the lower insulator. The longer the insulator the hotter the plug will operate; the shorter the insulator, the cooler it will operate. A spark plug that absorbs (or retains) little heat and remains too cool will accumulate deposits of lead, oil, and carbon, because it is not hot enough to burn them off. This leads to fouling and consequent misfiring.

A spark plug that absorbs too much heat will have no deposits, but the electrodes will burn away quickly and, in some cases, preignition may result. Preignition occurs when the spark plug tips get so hot that they ignite the air/fuel mixture before the actual spark fires. This premature ignition will usually cause a

TUNE-UP SPECIFICATIONS

Years	Models	Engine	Spark Plugs		Ignition Timing (deg.)	Idle Speed		Valve Clearance (in.)	
			Type	Gap (in.)		Man. Trans.	Auto. Trans.	In.	Exh.
1989-91	Truck	22R	W16EXR-U	0.031	0°	700	750 ①	0.008	0.012
		22R-E	or BPR5EY	0.031	5° BTDC ②	750			
		3VZE	K16R-U or BKR5EYA	0.031	10° BTDC ②	800	800	0.007-0.011	0.009-0.013
1989-91	4Runner	22R-E	W16EXR-U or BPR5GY	0.031	5° BTDC ②	750	750	0.008	0.0012
		3VZE	K16R-U or BKR5EYA	0.031	10° BTDC ②	800	800	0.007-0.011	0.009-0.013
1989-91	Land Cruiser	3F-E	W16EXR-U or BPR5EY	0.031	7° BTDC ②	—	650	0.008	0.0014

① 4WD 850

② Set to this spec w/jumper in place @ check connector

Spark Plugs

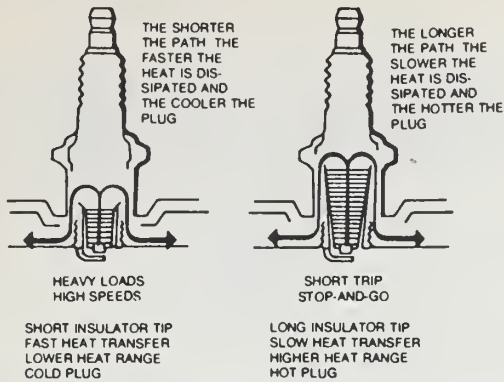
Spark plugs ignite the air and fuel mixture in the cylinder as the piston reaches the top of the compression stroke. The controlled explosion that results forces the piston down, turning the crankshaft and the rest of the drive train.

The average life of a spark plug is dependent on a number of factors: the mechanical condition of the engine, the type of fuel, the driving conditions and the driver. Although the standard factory plugs will last a considerable period of time, extended life may be gained in some engines by using platinum-tipped plugs. You must decide if the benefits outweigh the extra cost.

When you remove the spark plugs, check their condition.

pinging sound under conditions of low speed and heavy load. In severe cases, the heat may become high enough to start the air/fuel mixture burning throughout the combustion chamber rather than just to the front of the plug. In this case, the resultant explosion will be strong enough to damage pistons, rings, and valves.

In most cases the factory recommended heat range is correct; it is chosen to perform well under a wide range of operating conditions. However, if most of your driving is long distance, high speed travel, you may want to install a spark plug one step colder than standard. If most of your driving is of the short trip variety, when the engine may not always reach operating temperature, a hotter plug may help burn off the deposits normally accumulated under those conditions.



Correct spark plug heat range depends on your type of driving.

REMOVAL

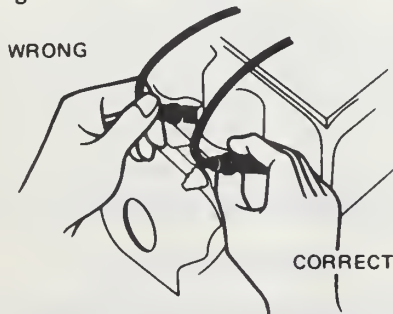
1. Number the wires so that you won't cross them when you replace them.
2. Remove the wire from the end of the spark plug by grasping the wire by the rubber boot. If the boot sticks to the plug, remove it by twisting and pulling at the same time. Do not pull wire itself or you will damage the core.
3. Use a spark plug socket to loosen all of the plugs about two turns. Depending on location of the plug, a short extension on the wrench can be very handy. Make certain to keep the line of the wrench exactly on the line of the plug; if the wrench is cocked to one side, the plug may break off. Breaking a plug will spoil your afternoon—and most of the next day as well.

NOTE: The cylinder head is cast from aluminum. Remove the spark plugs when the engine is cold, if possible, to prevent damage to the threads.

If removal of the plugs is difficult, apply a few drops of penetrating oil or silicone spray to the area around the base of the plug, and allow it some time to work.

4. If compressed air is available, apply it to the area around the spark plug holes. Otherwise, use a rag or a brush to clean the area. Be careful not to allow any foreign material to drop into the spark plug holes.

5. Remove the plugs by unscrewing them the rest of the way from the engine.



Never pull on the wire; always grasp the boot of the spark plug wire.

INSPECTION

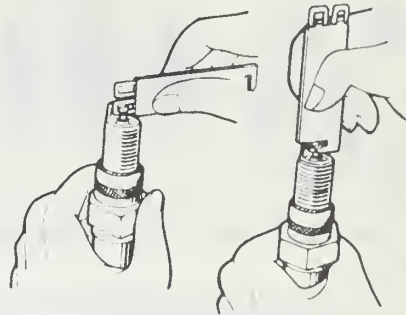
Check the plugs for deposits and wear (see the "Spark Plug Diagnosis" color section in the center of this book). If they are going to be replaced, clean the plugs thoroughly. This may be done with very fine sandpaper or a small flat file. Do not use a wire brush. Remember that any kind of deposit will decrease the efficiency of the plug. Plugs can be cleaned on a spark plug cleaning machine, which can sometimes be found in service sta-

tions. If the plugs are cleaned, the electrodes must be filed flat. Use an ignition points file, not an emery board or the like, which will leave deposits. The electrodes must be filed perfectly flat with sharp edges; rounded edges reduce the spark plug voltage by as much as 50%.

Check spark plug gap before installation. The ground electrode (the L-shaped one connected to the body of the plug) must be parallel to the center electrode and the specified-size wire gauge must fit in the gap with slight resistance. Correct gap for all truck, 4Runner and 1989-90 Land Cruiser engines is 0.031 in. (0.8mm). For 1991 Land Cruiser engines, the gap should be 0.043 in. (1.1 mm).

CAUTION

NEVER adjust the gap on a used platinum tipped spark plug!



The correct tool will both measure the electrode gap and adjust it.

Always check the gap on new plugs, too; any given plug may require different gaps for use in different engines. Do not use a flat feeler gauge when measuring the gap; the reading will be inaccurate. Wire gapping tools usually have a bending tool attached. Use that to adjust the side electrode until the proper distance is obtained. Absolutely never bend the center electrode. Also, be careful not to bend the side electrode too far or too often; it may weaken and break off within the engine, requiring removal of the cylinder head to retrieve it.

INSTALLATION

1. Lubricate the threads of the spark plugs with a drop of oil. Install the plugs by hand and tighten them just finger tight. Never attempt to perform the initial installation with a wrench; take care not to cross-thread them.

2. Tighten the spark plugs with the socket. Do not apply the same amount of force you would use for a bolt; just snug them in. If a torque wrench is available, tighten to 13 ft. lbs. (18 Nm).

3. Install the wires on their respective plugs. Make sure the wires are firmly connected. You will be able to feel them click into place. Additionally, make certain each wire is replaced into any clip or holder on its path.

Spark Plug Wires

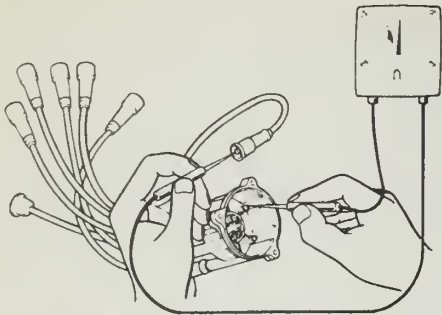
CHECKING AND REPLACEMENT

At every tune-up, visually inspect the spark plug cables for burns, cuts, or breaks in the insulation. Check the boots and the nipples on the distributor cap and coil. Replace any damaged wiring. Always replace spark plug wiring in sets, with a coil wire as well. Length is important; get the correct set for your vehicle.

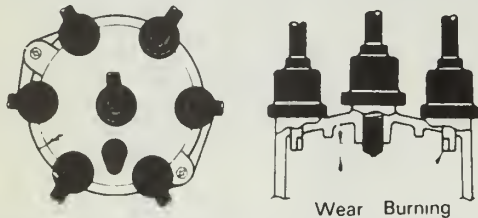
Every 36,000 miles or so, the resistance of the wires should be checked with an ohmmeter. Wires with excessive resistance will cause misfiring, and may make the engine difficult to start in damp weather. Generally, the useful life of the cables is 36,000-50,000 miles.

To check resistance, remove the distributor cap, leaving the

2 ENGINE PERFORMANCE AND TUNE-UP



Checking the high-tension wires with an ohmmeter.

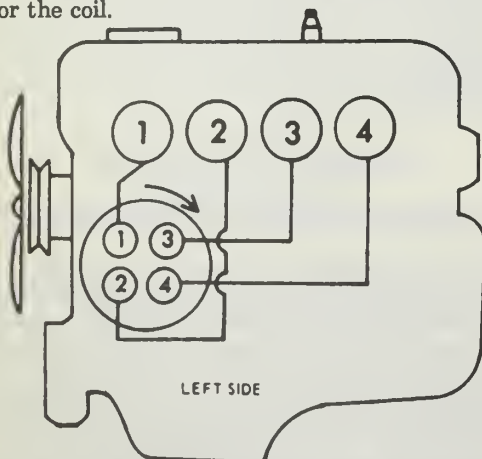


Always check inside the cap for any abnormal conditions.

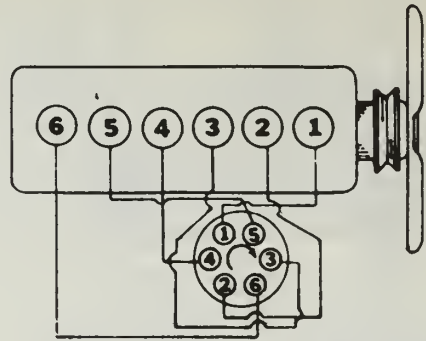
wires attached to the cap but removing them from the spark plugs. Look at each contact inside the cap for any sign of cracking or burning. A small amount of discoloration is normal but there should be no heavy burn marks or contact marks. Connect one lead of an ohmmeter to an electrode within the cap; connect the other lead to the corresponding spark plug terminal. Replace any wire which shows a resistance over 25,000Ω (25KΩ).

Test the high tension lead from the coil by connecting the ohmmeter between the center contact in the distributor cap and either of the primary terminals of the coil. If resistance is more than 25,000Ω, remove the cable from the coil and check the resistance of the cable alone. Anything over 15,000Ω is cause for replacement. It should be remembered that resistance is also a function of length; the longer the cable, the greater the resistance. Thus, if the cables on your truck are longer than the factory originals, resistance will be higher, quite possibly outside these limits. Toyota recommends the 25kΩ limit be observed in all cases.

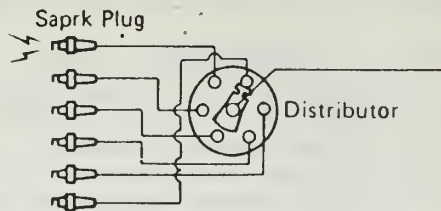
When installing new cables, replace them one at a time to avoid mixups. Start by replacing the longest one first. Install the boot firmly over the spark plug. Route the wire over the same path as the original. Insert the nipple firmly into the tower on the cap or the coil.



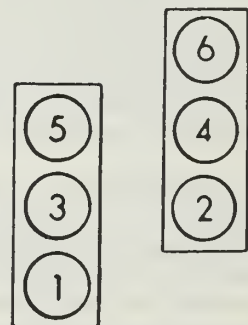
Firing order on all 4 cylinder engines is 1-3-4-2. 22R and 22R-E shown.



The 6 cylinder Land Cruiser uses a 1-5-3-6-2-4 pattern.



Firing Order:
1-2-3-4-5-6



Cylinder numbering and firing order for 3VZ-E V-6 engine.

FIRING ORDER

The firing order is the order in which spark is sent to each cylinder. The spark must arrive at the correct time in the combustion cycle or damage may result. For this reason, connecting the correct plug to the correct distributor terminal is critical. To avoid confusion, always replace the spark plug wires one at a time.

Electronic Ignition

PRECAUTIONS

1. Do not allow the ignition switch to be ON for more than ten minutes if the engine will not start.
2. When a tachometer is connected to the system, always connect the tachometer positive lead to the ignition coil negative terminal. Some tachometers are not compatible with this system; it is recommended that you consult with the manufacturer.
3. NEVER allow the ignition coil terminals to touch ground as it could result in damage to the igniter and/or the ignition coil itself.
4. Do not disconnect the battery when the engine is running.
5. Make sure that the igniter is always properly grounded to the body.

SYSTEM DESCRIPTION

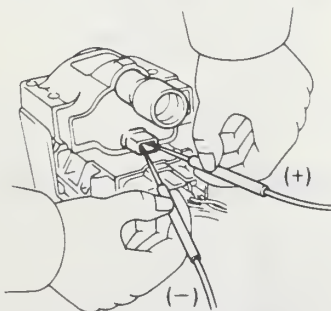
Electronic ignition systems offer many advantages over the conventional breaker points ignition system. By eliminating the points, maintenance requirements are greatly reduced. An electronic ignition system is capable of producing much higher voltage which in turn aids in starting, reduces spark plug fouling and provides better emission control.

The system Toyota uses consists of a distributor with a signal generator, an ignition coil and an electronic igniter. The signal generator is used to activate the electronic components of the igniter. It is located in the distributor and consists of three main components; the signal rotor, the pickup coil and the permanent magnet. The signal rotor (not to be confused with the normal rotor) revolves with the distributor shaft, while the pickup coil and the permanent magnet are stationary. As the signal rotor spins, the teeth on it pass a projection leading from the pickup coil. When this happens, voltage is allowed to flow through the system, firing the spark plugs. There is not physical contact and no electrical arcing, hence no need to replace burnt or worn parts.

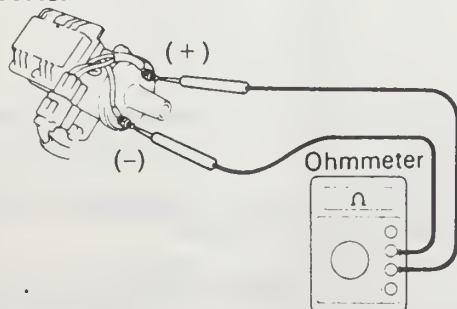
Service consists of inspection of the distributor cap, rotor and the ignition wires, replacing them as necessary. In addition, the air gap between the signal rotor and the projection on the pickup coil should be checked periodically. The resistances of the coil and pickup circuits should be measured periodically.

TESTING THE COIL

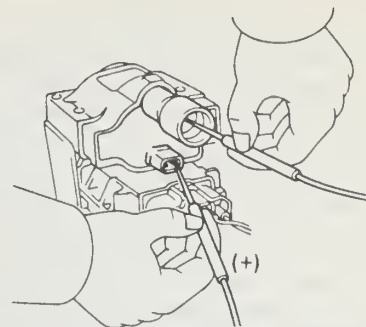
1. With the ignition switch OFF, carefully remove the high tension cable (coil-to-distributor wire) from the coil.
2. Carefully disconnect the smaller electrical connector from the coil. 1989-90 Land Cruisers and all 4 cylinder trucks and 4Runners do not have this small connector; battery wires run to external terminals on the coil. These terminals do not need to be undone.
3. Use an ohmmeter to test primary side resistance. Connect the probes to the 2 terminal pins of the small electrical connector or the two external terminals on each side of the coil.



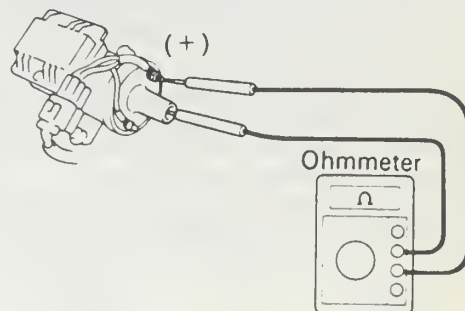
Checking coil primary resistance. The ohmmage is very small; make certain the meter is set on the correct scale.



Checking the coil primary resistance on coils with external terminals.



Checking secondary resistance.



Checking secondary resistance on coils with external terminals

4. Resistance should be:
 - 1989 22R and 3VZ-E engines: 0.4-0.5Ω
 - 1989,90 22R-E engine: 0.5-0.7Ω
 - 1990-91 3VZ-E engine: 0.4-0.5Ω
 - 1991 22R-E engine: 0.52-0.64Ω
 - 1989-90 3F-E engine: 0.52-0.64Ω
 - 1991 3F-E engine: 0.41-0.50Ω

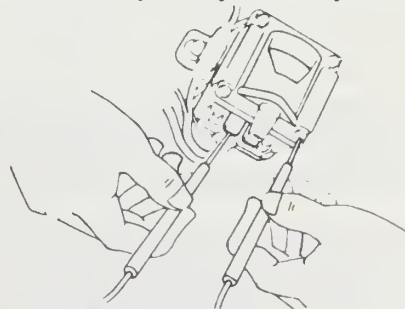
Note that these values are for cold coils. Perform the check before running the engine.

5. Check the secondary circuit resistance with the ohmmeter. Make certain the meter is set to a much higher scale than the previous test. Connect one probe of the meter to the positive coil terminal and the other to the high tension terminal.

6. Correct resistances for a cold coil are:
 - 1989 22R engines: 8.5-11.5kΩ
 - 1989 22R-E engines: 11.4-15.6kΩ
 - 1989-90 22R-E engine: 8.5-11.5kΩ
 - 1989-91 3VZ-E engine: 10.2-13.8kΩ
 - 1991 22R-E engine: 11.4-15.6kΩ
 - 1989-91 3F-E engine: 11.5-15.5kΩ
 - 1991 3F-E engine: 10.2-13.8kΩ

7. If either resistance is not within specifications, the coil must be replaced.

8. For the 1989 22R engine, measure resistance from the negative coil terminal to the body of the igniter. Resistance should be infinite (no continuity). If any continuity is found, replace the unit.



Checking the resistance to the Igniter on 1989 22R engines.

2 ENGINE PERFORMANCE AND TUNE-UP

AIR GAP

1. Remove the distributor cap. Inspect the cap for cracks, carbon tracks or a worn center contact. Replace it if necessary, transferring the wires one at a time from the old cap to the new one.

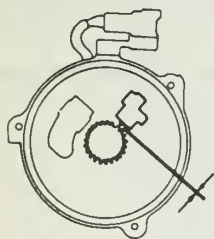
2. Pull the ignition rotor (not the signal rotor) straight up and remove it. Replace it if the contact is worn, burned or pitted. Do not file the contacts.

3. Turn the engine over (you may use a socket wrench on the front pulley bolt to do this) until the projection on the pickup coil is directly opposite the signal rotor tooth.

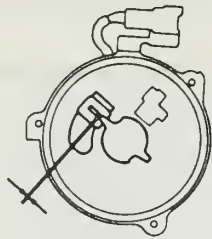
4. Use only a non-ferrous (paper, brass, or plastic) feeler gauge set. This means that they are non-magnetic; if you have any doubt, check the feeler with a magnet. If the magnet sticks, don't use that feeler gauge. Failure to pay attention to this rule may cause the car to not start.

5. Select a non-ferrous feeler blade of 0.30mm, and insert it into the pickup air gap. The gauge should just touch either side of the gap. The permissible range is 0.20–0.40mm (0.008–0.016 in.) except for 1989–90 Land Cruisers. These vehicles require only that the gap be greater than 0.2mm.

NOTE: The air gap is NOT adjustable. If the gap is not within specifications, the distributor must be replaced.

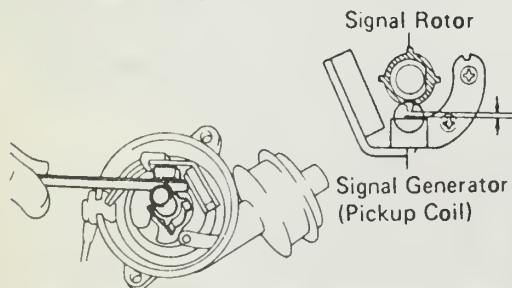


NE Pickup



G Pickup

Land Cruisers use may have either type of pick-up within the distributor.



Measuring the air gap on 22R and 22R-E distributors



The 3VZ-E distributor may be either type; note that the lobe-type must be measured at both pickups.

TESTING PICKUP COIL(S)

1. With the ignition OFF, carefully disconnect the connector in the harness coming from the side of the distributor.

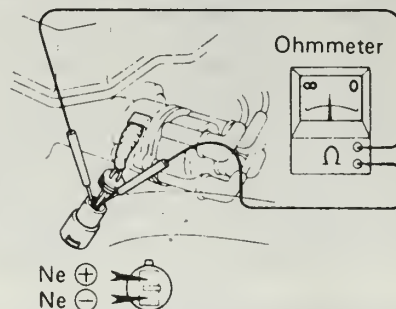
2. For 2-pin connectors, measure the resistance between the two terminals. Resistance for all 1989–90 vehicles is 140–180Ω. For 1991 vehicles, resistance should be 205–255Ω.

3. 3-pin connectors are used on the Land Cruisers. Hold the

connector so that the empty section of the 4-pin housing is in the lower left. The terminal

at the lower right is called G–. Test each of the other terminals to G–, looking for resistance of 140–180Ω on 1989–91 vehicles.

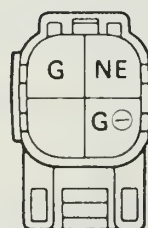
4. Four-pin connectors require you to hold the connector so that the square part of the housing is at the bottom. Viewing the connector in this position, the terminal on the lower right is called G–. Use the ohmmeter to check each other terminal to G–. Correct resistance for 1989–90 vehicles is 140–180Ω; for



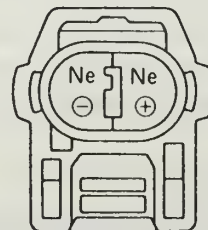
Two-pin pickup coil connector. Note the probes placed in the back of the connector – a handy trick to prevent connector damage.



A 4-pin pickup coil connector is used on 3VZ-E engines.



Land Cruiser pickup coil connector



Newer type of 2-pin connector found on 22R-E engines.

1991, it's 205–255Ω.

5. If any resistance is out of specification, the distributor housing assembly must be replaced.

SPARK TEST

The spark test is used to see if the ignition system is delivering electricity through the coil wire to the distributor. Use this

test as a preliminary test if the engine cranks but won't start. It's a simple test, but can give a nasty shock if not done correctly.

1. Disconnect the end of the coil wire at the distributor.
2. Use a well-insulated tool (such as ignition wire pliers) to hold the exposed end of the wire about ½ inch from the metal of the engine block.

CAUTION

Do not attempt to hold the wire with your bare hand. Use a much insulation as possible between the wire and the tool holding it. Do not stand on wet concrete while testing. Do not lean on the bodywork of the car while testing. The electrical charge will pass through the easiest path to ground — make certain it is not you. Make certain the metal ground point nearest the cable end is safe; don't choose components that might contain fluids or wires.

3. Have an assistant crank the engine by turning the ignition switch to the START position, but only for 1 or 2 seconds. Keep clear of moving parts under the hood, and keep clothing and hair well out of the way. If the cable end is the correct distance from solid metal, a distinct, blue-white spark should jump to the metal as the engine cranks.

4. The engine may be cranked in 1–2 second bursts. Longer cranking will cause the fuel injectors to deliver fuel into the cylinders, flooding the engine or at least fouling the spark plugs.

5. If no spark is present, turn the ignition switch OFF and proceed to check the resistance of the coil wire, the voltage supply to the coil (12 volts with ignition ON), the coil resistance, the resistance of the pickup coil and the air gap within the distributor.

PARTS REPLACEMENT

An electrical tune-up consists mostly of replacing the spark plugs and inspecting or replacing the distributor cap. The wires' resistance should be checked, but only replaced if necessary. These parts are not expensive and can prevent many embarrassing failures. Retailers and auto departments run sales which can save even more money.

Ignition Timing

Ignition timing is the measurement in degrees of crankshaft rotation at the instant the spark plug fires while the piston is on its compression stroke.

Ignition timing is adjusted by loosening the distributor locking device and turning the distributor in its mount.

Ideally, the air/fuel mixture in the cylinder will be ignited by the spark plug and just beginning its rapid expansion as the piston passes top dead center (TDC) of the compression stroke. If this happens, the piston will be beginning the power stroke just as the compressed air/fuel mixture starts to burn and expand. The expansion (explosion) of the air/fuel mixture will then force the piston down on the power stroke and turn the crankshaft.

It takes a fraction of a second for the spark from the plug to completely ignite the mixture in the cylinder. Because of this, the spark plug must fire before the piston reaches TDC, if the mixture is to be completely ignited as the piston passes TDC. This measurement is given in degrees of crankshaft rotation before the piston reaches top dead center (BTDC). If the ignition timing setting for your engine is seven (7°) BTDC, this means that the spark plug must fire at the time when the piston for that cylinder is 7° before reaching the top of its compression stroke. However, this only holds true while your engine is at idle speed.

As the engine accelerates from idle, the speed of the engine (Rpm, or revolutions per minute) increases. The increase in rpm means that the pistons are now traveling up and down much faster. Because of this, the spark plugs will have to fire even

sooner if the mixture is to be completely ignited as the piston passes TDC. To accomplish this, the distributor incorporates means to advance the timing of the spark as engine speed increases.

The distributor in your Toyota has at least two means of advancing the ignition timing. One is called centrifugal advance and is actuated by weights in the distributor. The other is called vacuum advance and is controlled by that larger circular housing on the side of the distributor. In many later models, the vacuum advance is replaced by full computerized control, thanks to the engine control unit or ECU.

This function is known as Electronic Spark Advance (ESA) and is accomplished by Toyota's programming of the ECU. By monitoring the Rpm, intake air volume, engine temperature, throttle position and other variables, the microprocessor decides the correct moment to trigger the spark for any engine operating condition from cold idle through wide open throttle. The system is simple, non-adjustable and reliable.

In addition, some early distributors have a vacuum retard mechanism which is contained in the same housing on the side of the distributor as the vacuum advance. The function of this mechanism is to retard the timing of the ignition spark under certain engine conditions. This causes more complete burning of the air/fuel mixture in the cylinder and consequently lowers exhaust emissions. Both the vacuum advance and the vacuum retard have vacuum hoses connected to them. Don't get them mixed up during removal.

Because these mechanisms change ignition timing, it is necessary to disconnect and plug the one or two vacuum lines from the distributor when setting the basic ignition timing.

If ignition timing is set too far advanced (BTDC), the ignition and expansion of the air/fuel mixture in the cylinder will try to force the piston down in the cylinder while it is still traveling upward. This causes engine "ping", a sound which resembles marbles being dropped into an empty tin can. If the ignition timing is too far retarded (after, or ATDC), the piston will have already started down on the power stroke when the air/fuel mixture ignites. This will cause the piston to be forced down only a portion of its travel, resulting in poor engine performance and lack of power.

Checking Ignition Timing

Ignition timing adjustment is checked with a timing light. This instrument is connected to the number one (No. 1) spark plug of the engine as well as to the two battery terminals. The timing light flashes every time an electrical current is sent from the distributor through the No. 1 spark plug wire to the spark plug.

Except for the 3F-E engine, the crankshaft pulley and the front cover of the engine are marked with a timing pointer and a timing scale. On Land Cruisers, the timing mark is found by removing the small rubber plug at the rear of the engine where it meets the transmission. The plug is located on the same side of the engine as the spark plugs.

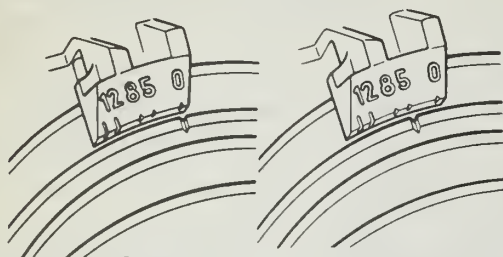
When the timing pointer is aligned with the 0 mark on the timing scale, the piston in the No. 1 cylinder is at TDC of its compression stroke. With the engine running, and the timing light aimed at the timing pointer and timing scale, the stroboscopic flashes from the timing light will allow you to check the ignition timing setting of the engine. The timing light flashes every time the spark plug in the No. 1 cylinder of the engine fires. Since the flash from the timing light makes the crankshaft pulley seem stationary for a moment you will be able to read the exact position of the piston in the No. 1 cylinder on the timing scale on the front of the engine.

Because your Toyota has electronic ignition, always use a timing light with an inductive pickup. This pickup simply clamps onto the No. 1 plug wire, eliminating any adapters. It is not as susceptible to crossfiring or false triggering, which may occur with a conventional light.

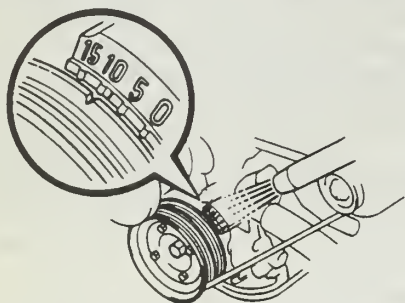
2 ENGINE PERFORMANCE AND TUNE-UP

22R

22R-E



Timing mark locations for the 4 cylinder 22R and 22R-E engines.



Timing mark location for the V6 3VZ-E engine

CHECKING AND ADJUSTMENT

22-R Carbureted Engine

1. Warm-up the engine, then turn it OFF. Connect a tachometer to both battery terminals and to the service connector coming from the distributor.

2. Clean off the timing marks. The marks are on the crankshaft pulley and timing cover. The timing notches in the crankshaft pulley are normally marked at the factory with red or white paint. You may want to retouch them if they are dark, using chalk or paint. Fluorescent (dayglow) paint is excellent for this purpose. You might have to bump the engine around with the starter (just touch the key to the START position very briefly) to find the pulley marks.

3. Connect a timing light according to the manufacturer's instructions.

4. Disconnect the vacuum line(s) from the distributor vacuum unit. Clamp or plug the line(s); golf tees are excellent for this job. Any vacuum leak will make the engine run poorly.

NOTE: On 22R engines with HAC (High Altitude Compensation system) there are two vacuum hoses which connect to the distributor. Both must be disconnected and plugged. These systems require an extra step in the timing procedure, found at the end of this section. You can obtain more information about the HAC in Section 4.

5. Be sure that the all wires are clear of the fan and moving belts, pulleys etc. Start the engine.

CAUTION

Keep fingers, clothes, tools, hair, and wiring leads clear of the all moving parts. Be sure that you are running the engine in a well ventilated area.

6. Allow the engine to run at idle speed with the gear shift in Neutral (manual) and PARK (P) with automatic transmission. Use the tachometer to check idle speed and adjust the idle if necessary.

CAUTION

Be sure that the parking brake is set and that the front wheels are blocked to prevent the vehicle from rolling.

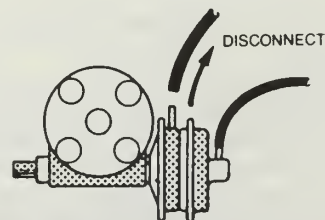
7. Point the timing light at the marks indicated in the chart and illustrations. With the engine at idle, timing should be at the specification given on the "Tune-Up Specifications" chart.

8. If the timing is not at the specification, loosen the pinch bolt (hold down bolt) at the base of the distributor just enough so that the distributor can be turned. Turn the distributor to advance or retard the timing as required. Once the proper marks are seen to align, timing is correct. Tighten the hold-down bolt.

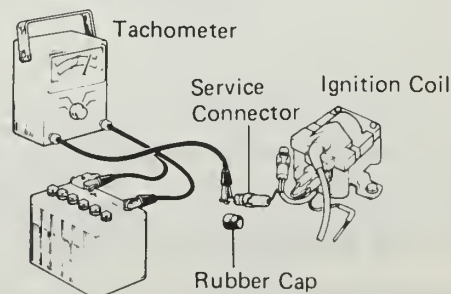
NOTE: Remember that you are using metal tools on a running engine. Watch out for moving parts and don't touch any of the spark plug wires with the wrench.

9. Recheck the timing. Stop the engine; disconnect the tachometer and timing light. Except for engines equipped with HAC, connect the vacuum line(s) to the distributor vacuum unit.

10. On engines with HAC (identified in the NOTE earlier), after setting the initial timing, reconnect the vacuum hose at the distributor. Recheck the timing. It should now be about 13° BTDC.



Twist and pull gently to disconnect the vacuum hoses at the distributor.



Connecting the tachometer to 22R distributor service connector.

11. If the advance is still about 8°, pinch the hose between the HAC valve and the three way connector. It should now be about 13°. If not, the HAC valve should be checked for proper operation.

22R-E, 3VZ-E and 3F-E Fuel Injected Engines

1. Warm up the engine, then turn it OFF. Connect a timing light to the engine following the manufacturer's instructions.

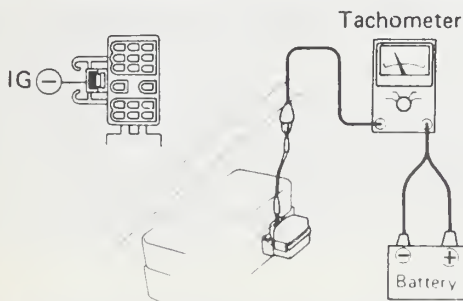
2. Connect a tachometer to both battery terminals. Connect the tachometer probe to the IG- terminal in the check connector box. The check connector box is located next to the underhood fuse and relay box on trucks and 4

Runners; for Land Cruisers, the check connector box is on the firewall. Use the correct adapter to insure a tight fit on the terminal. Not all tachometers, particularly older ones are electrically compatible with this system. Read instructions for your unit before using.

3. Start the engine and run it at idle. Check the idle speed on the tachometer; adjust it to specification if necessary.

4. At the check connector, use a small jumper wire to short the connector at terminal T or TE1 and terminal E1, as shown.

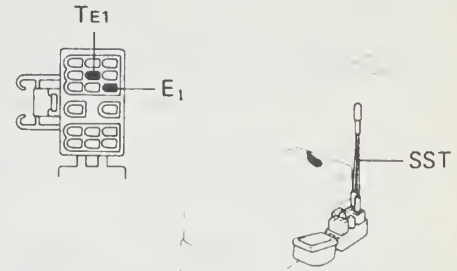
NOTE: This jumper will be used repeatedly during diagnostics in later Sections. Take the time to make a proper jumper with correct terminals or probes. It's a valuable special tool for very low cost.



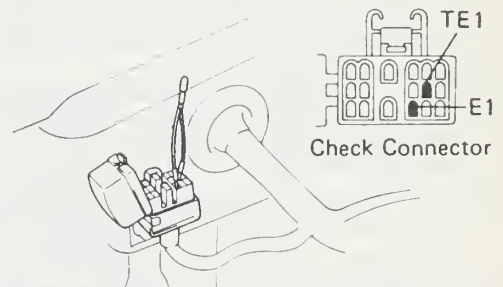
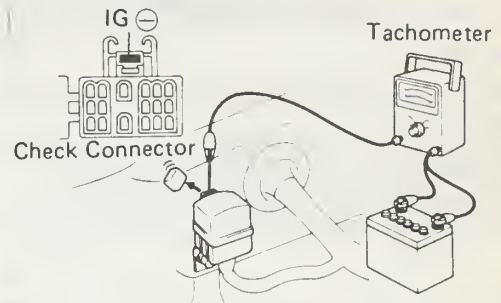
Use terminal IG- for connecting tachometers. 22R-E shown, connector position identical on all check connectors.

4. Loosen the distributor pinch bolt just enough that the distributor can be turned. Aim the timing light at the marks on the crankshaft pulley (or the drive plate on 3F-E) and slowly turn the distributor until the correct timing mark aligns with the pointer. Tighten the distributor pinch bolt.

5. Remove the jumper wire. Shut the engine OFF and remove the timing light and tachometer leads.



Terminal locations to be jumpered during timing check — 22R-E and 3VZ-E



Tachometer and timing jumper hook-ups — Land Cruiser with 3F-E engine.

VALVE LASH ADJUSTMENT

As part of every major tune-up or service interval, the valve clearance should be checked and adjusted if necessary. For all trucks and 4Runners covered by this book, the specification is every 30,000 miles or 36 months. For all Land Cruisers, the requirement is 15,000 miles or 18 months.

If the valve clearance is too large, part of the lift of the camshaft will be used up in removing the excessive clearance, thus the valves will not be opened far enough. This condition makes the valve train noisy as they take up the excessive clearance, and the engine will perform poorly, since a smaller amount of

2 ENGINE PERFORMANCE AND TUNE-UP

air/fuel mixture will be admitted to the cylinders. The exhaust valves will not open far enough to vent the cylinder completely; retained pressure (back pressure) will restrict the entry of the next air/fuel charge.

If the valve clearance is too small, the intake and exhaust valves will not fully seat on the cylinder head when they close. This causes internal cylinder leakage and prevents the hot valve from transferring some heat to the head and cooling off. Therefore, the engine will run poorly (due to gases escaping from the combustion chamber), and the valves will overheat and warp (since they cannot transfer heat unless they are firmly touching the seat in the cylinder head).

NOTE: While all valve adjustments must be as accurate as possible, it is better to have the valve adjustment slightly loose than slightly tight, as burnt valves may result from overly tight adjustments.

ADJUSTMENT

22R and 22R-E

1. Start the engine and warm it up to normal operating temperature.
2. Turn the engine OFF. Remove the air cleaner and housing, along with the hot air and cold air intake ducts.

CAUTION

Components will be hot. The engine head, block and radiator will be very hot.

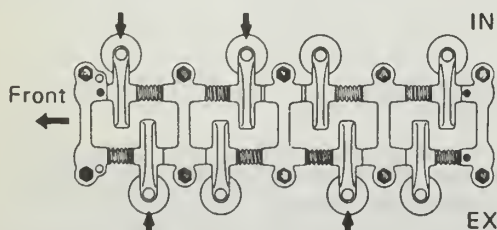
3. Remove any other hoses, cables, or wires attached to the valve cover. The valve cover (or cylinder head cover) is the domed steel item with the oil filler in it.
4. Remove the small nuts holding the valve cover and lift the cover off. Retrieve the rubber gasket and put it aside; it can be reused if not damaged or crushed out of shape. Be wary of hot oil dripping from the inside of the cover.
5. Use a large wrench on the crankshaft pulley bolt to turn the engine clockwise until the timing mark on the pulley to 0 on the scale. Turning the engine will be easier if the spark plugs are removed, but this is not required.

NOTE: Do not attempt to align the engine by using the ignition switch to turn the engine. Doing will splash hot oil onto everything in the area, including you.

6. Check that the rockers on No.1 cylinder are loose and the rockers on No.4 are under tension. (No.1 is closest to the radiator; No. 4 is closest to the firewall.) If this is true, the engine is aligned with No.1 piston at top dead center. If it is not true, turn the engine one full revolution clockwise and realign the timing mark at zero; recheck the rockers.

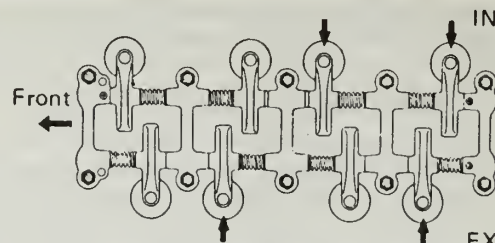
7. Adjust the clearance on half of the valves. Insert a feeler gauge and check for proper clearance between the top of the valve stem and the bottom of the rocker arm on the No. 1 intake valve. To adjust, loosen the lock nut on the end of the rocker arm and turn the adjusting screw until the clearance is correct. Refer to the Tune-Up Specifications chart. Tighten the lock nut and recheck the clearance; there should be a slight drag felt when the feeler gauge is pulled through the gap. Repeat the pro-

First



22R and 22R-E valve adjustment — first pass

Second



22R and 22R-E valve adjustment — second pass

cedure for No 1 exhaust, No 2 intake and No. 3 exhaust.

8. Turn the crankshaft pulley one full rotation clockwise until the marks align at 0 and repeat Step 2 for the other valves.

9. Clean the valve cover thoroughly with a lint-free rag. Wipe any oil off the cylinder head edges in the area of the valve cover gasket.

10. Fit the gasket into the valve cover, making sure it is not crimped or twisted. If the half-round rubber plugs came out of the valve cover, clean them and apply sealant to the part of the plug contacting the valve cover; install the half-round plug.

NOTE: The use of sealants on the valve cover gasket is not recommended.

11. Install the valve cover onto the head. Make certain is squarely seated and not pinching any adjacent wires or cables.

12. Install the valve cover retaining nuts. Tighten them to 4–5 ft. lbs. (48–60 inch lbs. or 6 Nm.) This is little more than finger tight; overtightening will deform the cover and cause leaks.

13. Connect the lines, hoses and cables which were removed for access. Make certain electrical and ignition wires are firmly held by their clips or brackets.

14. Install the air cleaner with the hoses and ductwork.

15. If still in place, remove the wrench and socket from the crankshaft pulley.

3VZ-E Engines

The valves should be checked with the engine cold. Generally, this means the vehicle has not been driven in at least 3 hours. Use a longer interval for hot climates. Overnight cold is best.

WARNING: The use of valve shim removing tools and a micrometer is required for this procedure. Toyota lists both shim removing tools as a set, SST 09248-55010; equivalent tools may be purchased through retail outlets. A micrometer is a precision measuring device. Do not attempt the procedure if the tools are not available.

1. Remove the air intake chamber:

- a. Tag and disconnect the throttle position sensor connector.

- b. Tag and disconnect the canister vacuum hose from the throttle body.

- c. Tag and disconnect the vacuum and fuel hoses from the pressure regulator.

- d. Tag and disconnect the PCV hose at the union.

- e. Tag and disconnect the No. 4 water by-pass hose from the union of the intake manifold.

- f. Tag and disconnect the No. 5 water by-pass hose from the water by-pass pipe.

- g. Tag and disconnect the cold start injector wire.

- h. Tag and disconnect the vacuum hose at the fuel filter.
- i. Remove the union bolt and two gaskets and then remove the cold start injector tube.

- j. Tag and disconnect the EGR gas temperature sensor wire.

- k. Tag and disconnect the EGR vacuum hoses at the air pipe and vacuum modulator.

l. On California vehicles, remove the EGR gas sensor connector.

m. Remove the nut, bolt and intake chamber stay.

n. Remove the 5 nuts, EGR valve with the pipes still connected and the 2 gaskets.

o. Disconnect the No. 1 air hose at the reed valve.

p. Remove the six bolts and two nuts and lift off the air intake chamber and gasket.

2. Disconnect the following connectors:

- Knock sensor
- No. 2 water temperature switch
- Start injector time switch
- Water temperature switch
- Right side ground strap
- Injector connectors

After the connectors are removed, remove the two bracket bolts and move the engine wire harness to an out of the way location.

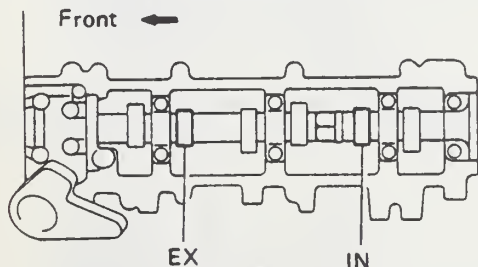
3. Remove the left and right valve covers (cylinder head covers).

4. Remove the spark plugs.

5. Use a wrench and turn the crankshaft clockwise until the notch in the pulley aligns with the timing mark 0 of the lower (No. 1) timing belt cover.

NOTE: Check that the valve lifters on the No. 1 cylinder are loose and those on No. 4 cylinder are tight. If not, turn the crankshaft one complete revolution clockwise and realign the marks.

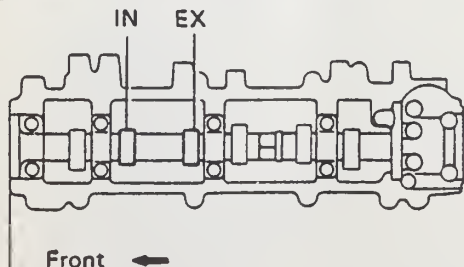
6. Using a flat feeler gauge, measure the clearance between the bottom of the camshaft lobe and the top surface of the valve lifter. (Actually, it's the top surface of the shim; more on this later.) This measurement should correspond to the one given in the Tune-Up Specifications chart. Check only the No. 6 intake valve and the No. 2 exhaust valve.



First set of valves to be checked on 3VZ-E engine – No. 6 Intake and No. 2 exhaust.

NOTE: If the measurement is within specifications, go on to the next step. If not, record the measurement taken for each individual valve. They will be used later to determine the required replacement shim sizes.

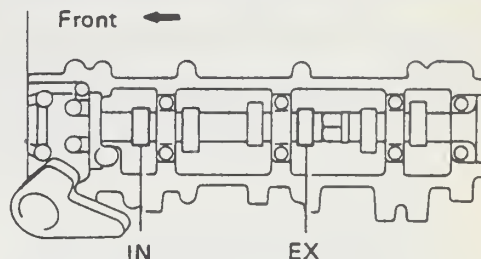
7. Turn the crankshaft $\frac{1}{3}$ of a revolution (120°). $\frac{1}{3}$ revolution is the equivalent of from 12 to 4 on a clock face. The No. 1 intake



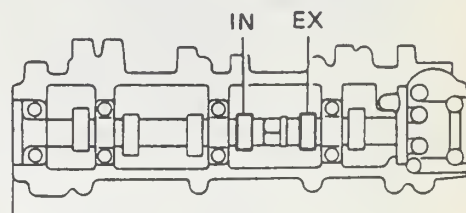
Second set of 3VZ-E valves to check – No. 1 Intake and No. 3 exhaust.

and the No. 3 exhaust valves should not be under tension from the cam lobes. Measure the clearances for these 2 valves only. Record any measurement that is out of specification.

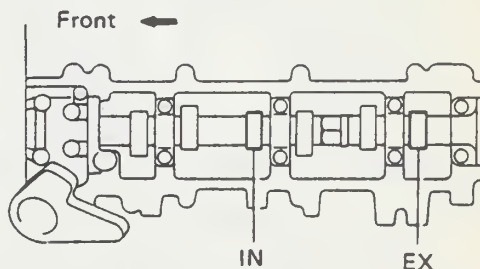
8. Turn the crankshaft $\frac{1}{3}$ of a revolution (120°) and measure the clearance at the No. 2 intake and the No. 4 exhaust valves. Record any measurement that is out of specification.



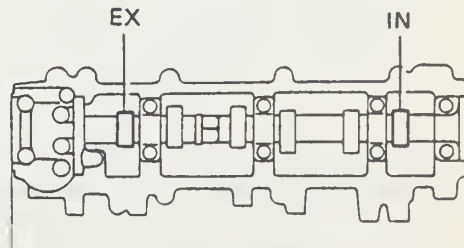
Third set of 3VZ-E valves – No. 2 Intake and No. 4 exhaust.



Fourth set of valves – No. 3 Intake and No. 5 exhaust.



Fifth set of valves to be checked – No. 4 Intake and No. 6 exhaust.



The last set of valves to be checked on 3VZ-E – No. 5 Intake and No. 1 exhaust.

9. Turn the crankshaft $\frac{1}{3}$ of a revolution (120°) and measure the clearance at the No. 3 intake and the No. 5 exhaust valves. Record any measurement that is out of specification.

10. Turn the crankshaft $\frac{1}{3}$ of a revolution (120°) and measure the clearance at the No. 4 intake and the No. 6 exhaust valves. Record any measurement that is out of specification.

11. Turn the crankshaft $\frac{1}{3}$ of a revolution (120°) and measure the clearance at the No. 5 intake and the No. 1 exhaust valves. Record any measurement that is out of specification.

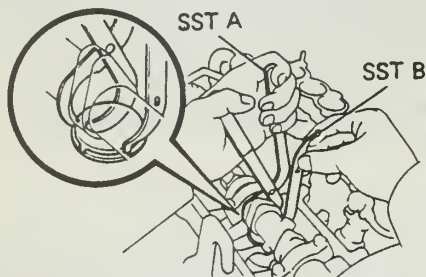
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NOTE: If the measurements for the six sets of valves are within specifications, you need go no further; the procedure is finished. If any clearance is not within specification, continue with Step 12.

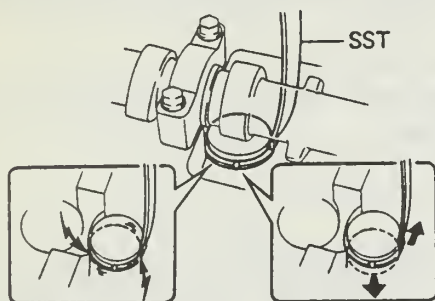
12. Turn the crankshaft clockwise until the camshaft lobe of the valve to be adjusted faces upward, taking tension off the valve.

13. Using a small awl, turn the valve lifter so that the notch is easily accessible.

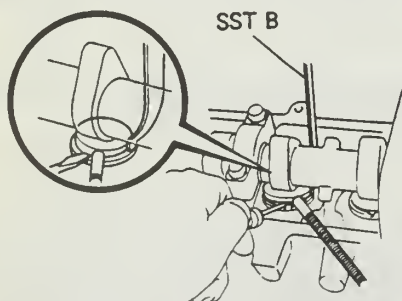
14. Install the scissors-type tool (SST A) on the lifter and then squeeze the handle so that the tool presses down the valve lifter evenly. Hold the valve lifter down with the single-bladed tool (SST B).



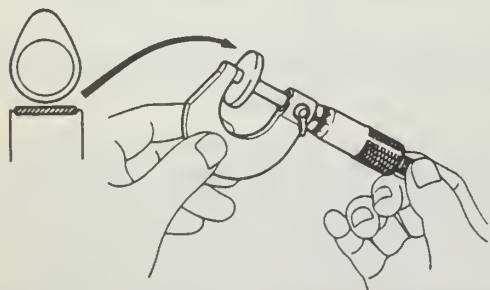
Use the special tools to compress the 3VZ-E valve lifter.



Correct positioning of the valve tools on 3VZ-E engines.



Removing the shim – 3VZ-E engine

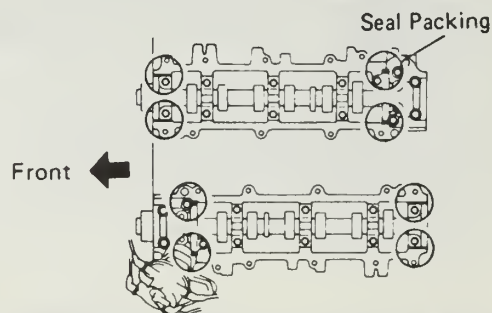


Use the micrometer to accurately measure shim thickness.

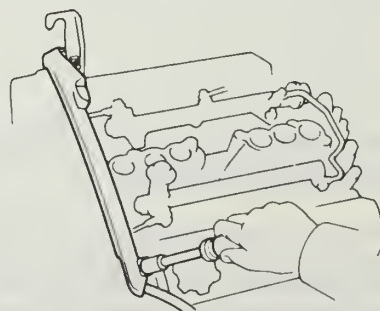
NOTE: For easy removal of the shim, set the special tool on the lifter so there is adequate space in the removal direction.

Shim No.	Thickness mm (in.)	Shim No.	Thickness mm (in.)
01	2.20 (0.0866)	27	2.85 (0.1122)
03	2.25 (0.0886)	29	2.90 (0.1142)
05	2.30 (0.0906)	31	2.95 (0.1161)
07	2.35 (0.0925)	33	3.00 (0.1181)
09	2.40 (0.0945)	35	3.05 (0.1201)
11	2.45 (0.0965)	37	3.10 (0.1220)
13	2.50 (0.0984)	39	3.15 (0.1240)
15	2.55 (0.1004)	41	3.20 (0.1260)
17	2.60 (0.1024)	43	3.25 (0.1280)
19	2.65 (0.1043)	45	3.30 (0.1299)
21	2.70 (0.1063)	47	3.35 (0.1319)
23	2.75 (0.1083)	49	3.40 (0.1339)
25	2.80 (0.1102)		

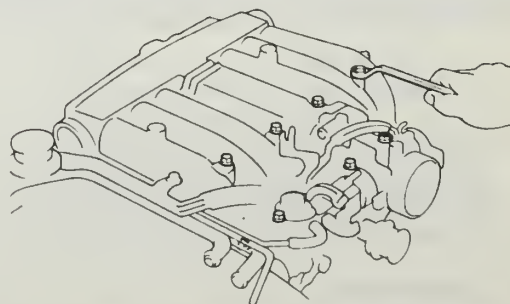
Shim thickness and shim number.



Apply sealant to these areas before installing V6 valve covers.



The engine wiring harness is held with 2 bolts.



Use great care in tightening the intake manifold bolts; always use a new gasket when installing.

Measured Clearance (mm)	Installed Shim Thickness (mm)																						
	2.200	2.225	2.250	2.275	2.300	2.325	2.350	2.375	2.400	2.420	2.440	2.450	2.460	2.480	2.500	2.510	2.520	2.530	2.540	2.550	2.560	2.570	2.580
0.000 - 0.004																							
0.005 - 0.014																							
0.015 - 0.024																							
0.025 - 0.029																							
0.030 - 0.034																							
0.035 - 0.044																							
0.045 - 0.054																							
0.055 - 0.064																							
0.065 - 0.074																							
0.075 - 0.079																							
0.080 - 0.084																							
0.085 - 0.094																							
0.095 - 0.104																							
0.105 - 0.114																							
0.115 - 0.124																							
0.125 - 0.129																							
0.130 - 0.134																							
0.135 - 0.144																							
0.145 - 0.154																							
0.155 - 0.164																							
0.165 - 0.174																							
0.175 - 0.179																							
0.180 - 0.280																							
0.281 - 0.284																							
0.285 - 0.294																							
0.295 - 0.304																							
0.305 - 0.314																							
0.315 - 0.324																							
0.325 - 0.329																							
0.330 - 0.334																							
0.335 - 0.344																							
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0.405 - 0.414																							
0.415 - 0.424																							
0.425 - 0.429																							
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0.555 - 0.564																							
0.565 - 0.574																							
0.575 - 0.579																							
0.580 - 0.584																							
0.585 - 0.594																							
0.595 - 0.604																							
0.605 - 0.614																							
0.615 - 0.624																							
0.625 - 0.629																							
0.630 - 0.634																							
0.635 - 0.644																							
0.645 - 0.654																							
0.655 - 0.664																							
0.665 - 0.674																							
0.675 - 0.679																							
0.680 - 0.684																							
0.685 - 0.694																							

Shim selection chart – Intake valves

2

[illegible]

Shim selection chart – Intake valves

Shim selection chart – Intake valves

2 ENGINE PERFORMANCE AND TUNE-UP

Measured Clearance (mm)	Installed Shim Thickness (mm)																			
	2.790	2.800	2.810	2.820	2.830	2.840	2.850	2.860	2.870	2.880	2.890	2.900	2.910	2.920	2.930	2.940	2.950	2.960	2.970	2.980
0.455-0.464																			41	
0.465-0.474																				
0.475-0.479																				
0.480-0.484																			43	
0.485-0.494																				
0.495-0.504																				
0.505-0.514																			45	
0.515-0.524																				
0.525-0.529																			47	
0.530-0.534																				
0.535-0.544																				
0.545-0.554																				49
0.555-0.564																				
0.565-0.574																				
0.575-0.579																				
0.580-0.584																				
0.585-0.594																				
0.595-0.604																				
0.605-0.614																				
0.615-0.624																				
0.625-0.629																				
0.630-0.634																				
0.635-0.644																				
0.645-0.654																				
0.655-0.664																				
0.665-0.674																				
0.675-0.679																				
0.680-0.684																				
0.685-0.694																				
0.695-0.704	43																			
0.705-0.714																				
0.715-0.724																				
0.725-0.729		45																		
0.730-0.734																				
0.735-0.744																				
0.745-0.754																				
0.755-0.764																				
0.765-0.774																				
0.775-0.779																				
0.780-0.784																				
0.785-0.794																				
0.795-0.804																				
0.805-0.814																				
0.815-0.824																				
0.825-0.829																				
0.830-0.834																				
0.835-0.844																				
0.845-0.854																				
0.855-0.864																				

Shim selection chart — Intake valves

Shim selection chart – exhaust valves

2

[illegible]

Shim selection chart – exhaust valves

Measured Clearance (mm)	Installed Shim Thickness (mm)																			
	2.790	2.800	2.810	2.820	2.830	2.840	2.850	2.860	2.870	2.880	2.890	2.900	2.910	2.920	2.930	2.940	2.950	2.960	2.970	2.980
0.000 - 0.004	13																			
0.005 - 0.014		15																		
0.015 - 0.019																				
0.020 - 0.024																				
0.025 - 0.034					17															
0.035 - 0.044																				
0.045 - 0.054																				
0.055 - 0.064																				
0.065 - 0.069																				
0.070 - 0.074																				
0.075 - 0.084																				
0.085 - 0.094																				
0.095 - 0.104																				
0.105 - 0.114																				
0.115 - 0.119																				
0.120 - 0.124																				
0.125 - 0.134																				
0.135 - 0.144																				
0.145 - 0.154																				
0.155 - 0.164																				
0.165 - 0.169																				
0.170 - 0.174																				
0.175 - 0.184																				
0.185 - 0.194																				
0.195 - 0.204																				
0.205 - 0.214																				
0.215 - 0.219																				
0.220 - 0.319																				
0.320 - 0.324	27																			
0.325 - 0.334																				
0.335 - 0.344																				
0.345 - 0.354		29																		
0.355 - 0.364																				
0.365 - 0.369																				
0.370 - 0.374																				
0.375 - 0.384																				
0.385 - 0.394																				
0.395 - 0.404																				
0.405 - 0.414																				
0.415 - 0.419																				
0.420 - 0.424																				
0.425 - 0.434																				
0.435 - 0.444																				
0.445 - 0.454																				
0.455 - 0.464																				
0.465 - 0.469																				

Shim selection chart — exhaust valves

2 ENGINE PERFORMANCE AND TUNE-UP

Measured Clearance (mm)	Installed Shim Thickness (mm)															
	2.790	2.800	2.810	2.820	2.830	2.840	2.850	2.860	2.870	2.880	2.890	2.900	2.910	2.920	2.930	2.940
0.470-0.474															39	
0.475-0.484																
0.485-0.494																
0.495-0.504															41	
0.505-0.514																
0.515-0.519															43	
0.520-0.524																
0.525-0.534																
0.535-0.544															45	
0.545-0.554																
0.555-0.564																
0.565-0.569																47
0.570-0.574																
0.575-0.584																49
0.585-0.594																
0.595-0.604																
0.605-0.614																
0.615-0.619																
0.620-0.624																
0.625-0.634																
0.635-0.644																
0.645-0.654																
0.655-0.664																
0.665-0.669																
0.670-0.674																
0.675-0.684																
0.685-0.694																
0.695-0.704																
0.705-0.714																
0.715-0.719																
0.720-0.724																
0.725-0.734	43															
0.735-0.744																
0.745-0.754																
0.755-0.764		45														
0.765-0.769																
0.770-0.774																
0.775-0.784																
0.785-0.794																
0.795-0.804																
0.805-0.814																
0.815-0.819																
0.820-0.824																
0.825-0.834																
0.835-0.844																
0.845-0.854																
0.855-0.864																
0.865-0.869																
0.870-0.874																
0.875-0.884																
0.885-0.894																
0.895-0.904																

Shim selection chart — exhaust valves

15. Using a small screwdriver and a magnet, remove the valve shim.

16. Carefully measure the thickness of the old shim with a micrometer. Locate that particular measurement in the "Installed Shim Thickness" column of the accompanying charts, then locate the recorded clearance measurement (from Step 6-11) for that valve in the "Measured Clearance" column of the charts. Index the two columns to arrive at the proper replacement shim thickness.

NOTE: Replacement shims are available in 25 sizes, in increments of 0.05mm, from 2.200mm to 3.400mm.

17. Install the new shim, remove the special tool and then recheck the valve clearance.

18. Consult the clearances recorded earlier and perform Steps 12-17 for any other valve needing adjustment. Always turn the engine clockwise as you face the front of the motor.

19. Install the spark plugs.

20. Install the valve covers. Place the gasket on the cover; install small amounts of sealant to the 8 locations shown. Install the covers and tighten the 11 bolts only to 4-5 ft. lbs. Do not overtighten.

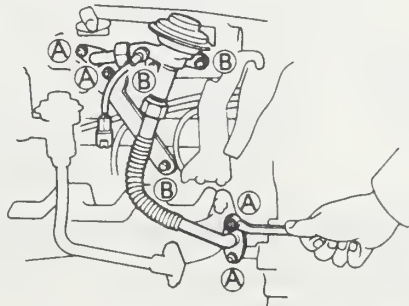
21. Install the engine wire harness with the two bolts. Connect every connector removed in Step 2.

22. Place a new gasket on the intake manifold. Install the air intake chamber with the 6 bolts and 2 nuts. Tighten them evenly to 13 ft. lbs. (18 Nm).

23. Connect the No.1 air hose to the reed valve.

24. Place two new gaskets on the intake chamber and right-side exhaust chamber. Install the EGR valve with the pipes to the intake chamber and manifold.

25. Install the air intake chamber stay. Refer to the illustration for bolt designation. Tighten bolts A to 22 ft. lbs. (29 Nm). Tighten bolts B to 13 ft. lbs. (18 Nm).



EGR system bolts must be correctly set to avoid damage.

26. Connect the EGR hoses to the air pipe and the vacuum modulator. On California vehicles, connect the EGR temperature sensor connector.

27. Use a new gasket and install the cold start injector; tighten the union (banjo) bolt to 13 ft. lbs. (18 Nm).

28. Install the vacuum hose to the fuel filter and connect the cold start injector wiring connector.

29. Install the No.5 water by-pass hose to the water bypass pipe. Connect the No. 4 water bypass hose to the union at the intake manifold.

30. Connect the PCV hose. Connect the vacuum and fuel hoses to the pressure regulator.

31. Connect the canister vacuum hose to the throttle body.

32. Attach the wiring connector to the throttle body.

3F-E Engines

1. Start the engine and allow it to reach normal operating temperature.

2. Stop the engine. Remove any cables, hoses, wires, etc., which are attached to the valve cover and remove the valve cover. Don't lose the small nuts or seal washers.

CAUTION

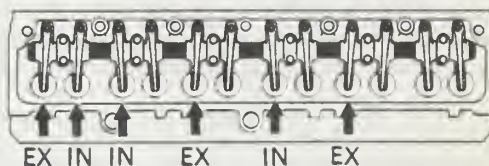
Components will be hot. The engine head, block and radiator will be very hot.

3. Use a wrench to turn the crankshaft pulley bolt clockwise until the timing marks are aligned at 0. Since the timing marks are at the back of the engine, an assistant is useful.

4. Once the timing marks are aligned, check the two rocker arms closest to the front of the motor; they should be loose. If not, rotate the engine one full rotation and realign the timing marks at zero. Now, the rockers are loose.

5. Check the clearance between each of the rocker arms and valve stems for the first set of valves, as shown, using a feeler gauge. Refer to the Tune-Up Specifications chart.

Front ← First

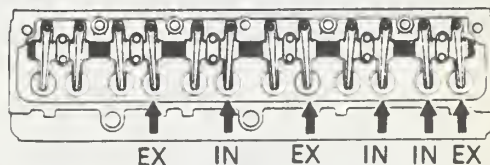


Adjust this set of valves FIRST on the 3F-E engine

6. If the clearance is incorrect, loosen the locknut and turn the adjusting screw as required to gain correct clearance. The feeler gauge should pass with just the slightest drag. Tighten the locknut and recheck the clearance.

7. When all valves in the first set are adjusted, turn the crankshaft one full rotation clockwise. The two rockers closest to the firewall or back of the motor should be loose. Repeat the measuring and adjusting procedure for each valve in the second set, as shown.

Front ← Second



Adjust these valves SECOND on the 3F-E engine

8. After adjusting all of the valves, install a new valve cover gasket on the cover. Install the valve cover, tightening the bolts to 6 ft. lbs. (72 inch lbs. or 8 Nm). Install any other components which were removed during Step 2. Make certain all wires and cables are properly held by the clamps or brackets.

9. Recheck the engine idle speed and adjust if necessary.

IDLE SPEED AND MIXTURE

To meet U.S. emissions regulations, the mixture adjusting screw on the carbureted 22R engine is preadjusted and plugged by Toyota. Adjusting this screw is not part of routine maintenance. Access to the screw requires removal of the carburetor. Full details of re-setting the air/fuel mixture after a carburetor overhaul are covered in Section 5. In virtually all cases, the air/fuel mixture screw is NOT the cause of a problem. Even if the engine is tested with an emissions analyzer, incorrect mixture is almost always caused by air leaks in the system or faulty internal carburetor parts (clogged jets, mis-adjusted floats, etc.). Toyota recommends all mixture adjustments be handled by a professional mechanic equipped with the proper emissions test equipment.

On the fuel injected engines, fuel mixture is handled by the computer, based on signals from the oxygen sensor in the ex-

2 ENGINE PERFORMANCE AND TUNE-UP

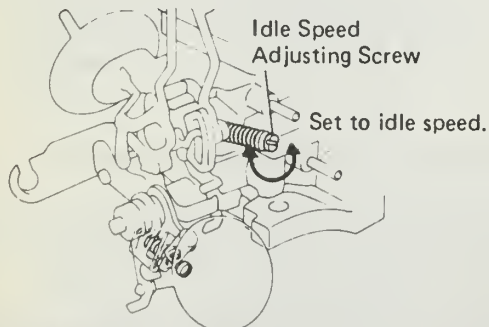
haust system and many other engine sensors. By having a "picture" of the engine operating conditions at any given moment, the computer determines the exact amount of fuel to maintain proper combustion and signals the injectors accordingly. Any investigation of the air/fuel mixture on a fuel injected engine requires the use of an HC/CO emissions tester, well out of the reach of the home mechanic.

IDLE ADJUSTMENT

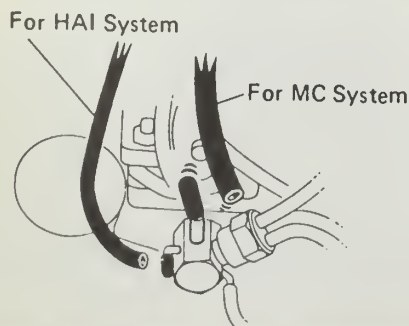
22R Engines

Before attempting to set the idle speed, the following conditions must be met: Air cleaner installed with all ducts, hoses, etc. intact, engine fully warmed and choke plate open, all electric accessories switched OFF, all vacuum lines connected, transmission in NEUTRAL and parking brake set and engine running at normal temperature.

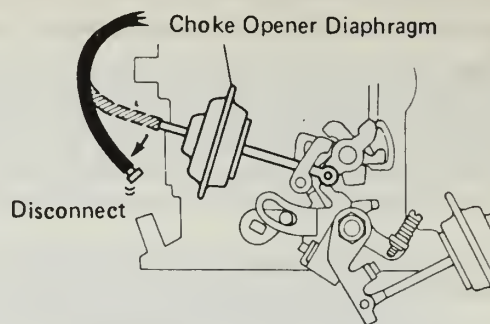
1. Connect a tachometer to the engine.
2. Set the curb idle speed by turning the adjusting screw on the side (not the bottom) of the carburetor. Correct idle speed is 700 rpm.
3. Turn the ignition OFF. Remove the air cleaner. Remove and plug the hoses for both the HAI and MC systems.
4. Disconnect the hose from the choke opener diaphragm and plug the hose end. This shuts off the choke opener system.
5. Disconnect the hose from the EGR valve.
6. Hold the throttle plate (in the bottom of the carburetor) slightly open and at the same time push the choke plate (top of the carb) closed. Hold the choke closed while releasing the throttle plate. This sounds tricky but is easily accomplished with a thin tool.
7. Start the engine but DO NOT touch the accelerator. The engine is running at high idle, as it would if started cold.
8. Set the fast idle speed by adjusting the lower screw on the carburetor. Correct idle speeds are: 49 State and Canada, 3000 rpm and California, 2600 rpm.
9. Stop the engine. Remove the tachometer. Connect the vacuum hoses to the correct locations.



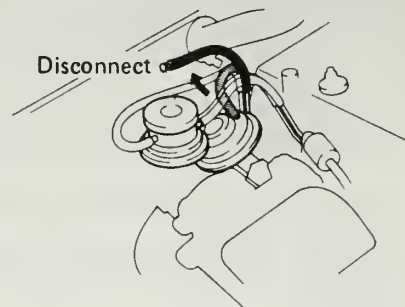
Curb Idle speed adjusting screw — 22R engine



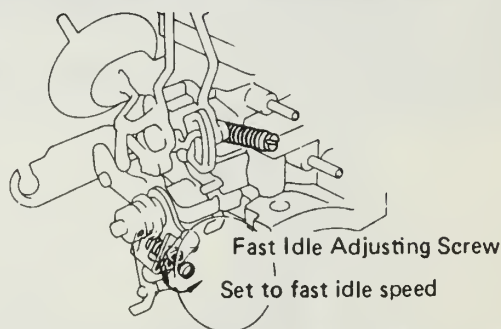
Remove and plug these hoses before setting fast idle on 22R engine.



Disconnect the choke opener.



The EGR valve must be disconnected before setting fast idle on 22R.



Use the lower adjusting screw to set fast idle.

10. Install the air cleaner assembly.

22R-E and 3VZ-E Engines

1. Make sure that the air cleaner is installed properly, all air intake system pipes and hoses are connected, all vacuum lines are connected properly.
2. Make sure that all Electronic Fuel Injection (EFI) system wiring connectors are fully plugged.
3. Run the engine until it reaches normal operating temperature, switch off all accessories and put the transmission in NEUTRAL. Turn off the engine.
4. Connect a tachometer to the engine. Be sure to connect the terminal of the tachometer to the IG— terminal of the check connector box or damage to the igniter will result.

NOTE: Not all tachometers are compatible with this ignition system, it is recommended that you check with the manufacturer before using a particular tachometer.

CAUTION

NEVER allow the tachometer terminal to touch ground as it could result in damage to the igniter and/or the ignition coil

5. Restart the engine and run it at 2,500 rpm for about 2 minutes.
6. Remove the plug from the idle adjuster; turn the idle speed

adjusting screw until the idle speed is 750 rpm for 22R-E or 800 rpm for 3VZ-E.

7. Recheck the idle speed once more and install the plug into the idle speed adjuster. Turn the ignition OFF and disconnect the tachometer.

3F-E

The idle speed on the 3F-E Land Cruiser engine is electroni-

cally controlled by the fuel injection computer. The Idle Speed Control (ISC) system electrically oversees the proper idle speed for all operating conditions. This is a good news/bad news arrangement. The bad news is that you can't adjust it; the good news is that it rarely, if ever, needs adjusting. Any roughness or uneven idle is almost always due to other causes such as a clogged injector, air leak or loose, corroded terminals in the wiring harness.

Diagnosis of Spark Plugs

Problem	Possible Cause	Correction
Brown to grayish-tan deposits and slight electrode wear.	• Normal wear.	• Clean, regap, reinstall.
Dry, fluffy black carbon deposits.	• Poor ignition output.	• Check distributor to coil connections.
Wet, oily deposits with very little electrode wear.	• "Break-in" of new or recently overhauled engine. • Excessive valve stem guide clearances. • Worn intake valve seals.	• Degrease, clean and reinstall the plugs. • Refer to Section 3. • Replace the seals.
Red, brown, yellow and white colored coatings on the insulator. Engine misses intermittently under severe operating conditions.	• By-products of combustion.	• Clean, regap, and reinstall. If heavily coated, replace.
Colored coatings heavily deposited on the portion of the plug projecting into the chamber and on the side facing the intake valve.	• Leaking seals if condition is found in only one or two cylinders.	• Check the seals. Replace if necessary. Clean, regap, and reinstall the plugs.
Shiny yellow glaze coating on the insulator.	• Melted by-products of combustion.	• Avoid sudden acceleration with wide-open throttle after long periods of low speed driving. Replace the plugs.
Burned or blistered insulator tips and badly eroded electrodes.	• Overheating.	• Check the cooling system. • Check for sticking heat riser valves. Refer to Section 1. • Lean air-fuel mixture. • Check the heat range of the plugs. May be too hot. • Check ignition timing. May be over-advanced. • Check the torque value of the plugs to ensure good plug-engine seat contact.
Broken or cracked insulator tips.	• Heat shock from sudden rise in tip temperature under severe operating conditions. • Improper gapping of plugs.	• Replace the plugs. Gap correctly.

2 ENGINE PERFORMANCE AND TUNE-UP

TORQUE SPECIFICATIONS

Component	English	Metric
Spark plugs:	13 ft. lbs.	18 Nm
Valve cover retaining nuts		
22R and 22R-E:	48-60 inch lbs.	6 Nm
3VZ-E Engines:	48-60 inch lbs.	6 Nm
3F-E Engines:	72 inch lbs.	8 Nm
Air intake chamber bolts and nuts:	13 ft. lbs.	18 Nm
Air intake chamber stay*		
Bolts A:	22 ft. lbs.	29 Nm
Bolts B:	13 ft. lbs.	18 Nm
*Refer to the illustration for bolt designation		
Cold start injector union bolt:	13 ft. lbs.	18 Nm

3 Engine and Engine Overhaul

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3 ENGINE AND ENGINE OVERHAUL

ENGINE ELECTRICAL

UNDERSTANDING BASIC ELECTRICITY

Understanding the basic theory of electricity makes electrical troubleshooting much easier. Several gauges are used in electrical troubleshooting to see inside the circuit being tested. Without a basic understanding, it will be difficult to perform testing procedures.

Electricity is the flow of electrons, hypothetical particles thought to constitute the basic "stuff" of electricity. In a comparison with water flowing in a pipe, the electrons would be the water. As the flow of water can be measured, the flow of electricity can also be measured. The unit of measurement is amperes, frequently abbreviated "amps". An ammeter will measure the actual amount of current flowing in the circuit.

Just as the water pressure is measured in units such as pounds per square inch, electrical pressure is measured in volts. When a voltmeter's two probes are placed on two portions of an electrical circuit with different electrical pressures, current will flow through the voltmeter and produce a reading which indicates the difference in electrical pressure between the two parts of the circuit.

While increasing the voltage in a circuit will increase the flow of current, the actual flow depends not only on voltage, but on the resistance of the circuit. Resistance is just that, the amount of force the wire and all components offer against the passage of the electrons. Just as a hose must be larger to accommodate a greater volume and/or pressure of water, so must electrical wires be sized according to their loads. High amperage loads, such as a starter, require large diameter cables; a low amperage circuit such as the back-up lamps can use much smaller wire.

The standard unit for measuring circuit resistance is an ohm, measured by an ohmmeter. The ohmmeter is somewhat similar to an ammeter, but incorporates its own source of power so that a standard voltage is always present. An ohmmeter can be used also for testing continuity through a circuit.

An actual electric circuit consists of four basic parts. These are: the power source such as an alternator or battery; a hot wire or feed, which conducts the electricity under a relatively high voltage to the component supplied by the circuit; the load, such as a lamp, motor, resistor, or relay coil which will use the electricity; and the ground path or wire, which carries the current back to the source under very low voltage. In such a circuit, the bulk of the resistance exists between the point where the hot wire is connected to the load and the point where the load is grounded. In many vehicles, the frame, which is made of steel, is used as a part of the ground circuit for many of the electrical devices.

Remember that, in electrical testing, the voltmeter is connected in parallel with the circuit being tested (without disconnecting any wires) and measures the difference in voltage between the locations of the two probes. The ammeter is connected in series with the load (the circuit is separated at one point and the ammeter inserted so it becomes a part of the circuit). The ohmmeter is self-powered, so that all other power in the circuit must be off; the portion of the circuit to be measured should be checked at either end by one of the probes of the meter.

For any electrical system to operate, it must make a complete circuit. This simply means that the power flow from the battery must make a complete circle. When an electrical component is operating, power flows from the battery to the component, passes through the component causing it to perform its function (lighting a light bulb) and then returns to the battery through the ground circuit.

Perhaps the easiest way to visualize this is to think of connecting a light bulb with two wires attached to it to your battery. The battery in your truck has two posts (negative and positive). If one of the two wires attached to the light bulb was attached to the negative post of the battery and the other wire was attached

to the positive post of the battery, you would have a complete circuit. Current from the battery would flow out one post, through the wire attached to it and then to the light bulb, causing it to light. It would then leave the light bulb, travel through the ground path and return to the battery.

The normal automotive circuit differs from this simple example in two ways. First, instead of having a return wire from the bulb to the battery, the light bulb returns the current to the battery through the chassis of the vehicle. Since the negative battery cable is attached to the chassis and the chassis is made of electrically conductive metal, the chassis of the vehicle can serve as a ground wire to complete the circuit. Secondly, most automotive circuits contain switches to turn components on and off.

Some electrical components requiring a large amount of current to operate also have a relay in their circuit. Since these circuits carry a large amount of current, the thickness of the wire in the circuit (gauge size) is also greater. If this large wire were connected from the component to the control switch on the instrument panel, and then back to the component, a voltage drop would occur in the circuit. Also, the switch would be required to handle a large amperage, making the switch physically large and bulky.

To prevent these problems, an electromagnetic switch (relay) is used. The large wires in the circuit are connected from the battery to one side of the relay, and from the opposite side of the relay to the component. The relay is normally open, preventing current from passing through the circuit. An additional, smaller, wire is connected from the relay to the control switch for the circuit. When the control switch is turned on, it grounds the smaller wire from the relay and completes the circuit. When the control switch is turned on, it grounds the smaller wire from the relay. The main switch inside the relay closes, sending power to the component without routing the main power through the inside of the car. Some common circuits which may use relays are the horn, headlights, starter and rear window defogger systems.

Every complete circuit must include a load—something to use the electricity coming from the source. If you were to connect a wire between the two terminals of the battery (DON'T do this) without the light bulb, the battery would attempt to deliver its entire power supply from one pole to another almost instantly. This is a short circuit. The electricity is taking a short-cut to get to ground and is not being used by any load in the circuit. This sudden and uncontrolled electrical flow can cause great damage to other components in the circuit and can develop a tremendous amount of heat. A short in an automotive wiring harness can develop sufficient heat to melt the insulation on all the surrounding wires and reduce a multi-wire cable to one sad lump of plastic and copper. Two common causes of shorts are broken insulation (thereby exposing the wire to contact with surrounding metal surfaces) or a failed switch (the pins inside the switch come out of place, touch each other and reroute the electricity).

It is possible for larger surges of current to pass through the electrical system of your car. If this surge of current were to reach the load in the circuit, it could burn it out or severely damage it. To prevent this, fuse and/or circuit breakers and/or fusible links are connected into the supply wires of the electrical system. These items are nothing more than a built-in weak spot in the system. It's much easier to go to a known location (the fusebox) to see why a circuit is inoperative than to dissect 15 feet of wiring under the dashboard, looking for what happened.

When an electrical current of excessive power passes through the fuse, the fuse blows and breaks the circuit, preventing the passage of current and protecting the components.

A circuit breaker is basically a self-repairing fuse. It will open the circuit in the same fashion as a fuse, but when either the short is removed or the surge subsides, the circuit breaker resets itself and does not need replacement.

A fuse link (fusible link or main link) is a wire that acts as a fuse. It is normally connected between the starter relay and the main wiring harness under the hood. Since the starter is the highest electrical draw on the car, an internal short during starter use could direct about 130 amps into the wrong places. Consider the damage potential of introducing this current into a system whose wiring is rated at 15 amps and you'll understand the need for protection. Since this link is very early in the electrical path, it's the first place to look if nothing on the car works but the battery seems to be charged and is properly connected.

Electrical problems generally fall into one of three areas:

1. The component that is not functioning is not receiving current.
2. The component itself is not functioning, or not functioning properly.
3. The component is not properly grounded; the return path to the battery is incomplete.

Problems that fall into the first category are by far the most complicated. It is the current supply system to the component which contains all the switches, relays, fuses, etc.

The electrical system can be checked with a test light and a jumper wire. A test light is a device that looks like a pointed screwdriver with a wire attached to it. It has a light bulb in its handle. A jumper wire is a piece of insulated wire with an alligator clip attached to each end.

If a light bulb is not working, you must follow a systematic plan to determine which of the three causes is the villain.

1. Turn on the switch that controls the inoperable bulb.
2. Disconnect the power supply wire from the bulb.
3. Attach the ground wire on the test light to a good metal ground.
4. Touch the probe end of the test light to the end of the power supply wire that was disconnected from the bulb. If the bulb is receiving current, the test light will go on.

NOTE: If the bulb is one which works only when the ignition key is turned on (example: turn signal), make sure the key is turned ON. The ignition switch serves as a Grand Master switch for many other circuits.

If the test light does not go on, then the problem is in the circuit between the battery and the bulb. As mentioned before, this includes all the switches, fuses, and relays in the system. Use the wiring diagrams; find the bulb on the diagram. Follow the wire that runs back to the switch, fuse, etc. The problem is an open circuit between the battery and the bulb.

If the fuse is blown and, when replaced, immediately blows again, there is a short circuit in the system which must be located and repaired. (Don't neglect the possibility of the bulb filament being shorted inside the bulb; it's happened.) If there is a switch in the system, bypass it with a jumper wire. This is done by connecting one end of the jumper wire to the power supply wire into the switch and the other end of the jumper wire to the wire coming out of the switch. Again, consult the wiring diagram. If the test light lights with the jumper wire installed, the switch or whatever was bypassed is defective.

NOTE: Never substitute the jumper wire for the bulb or other load in the circuit—the load is required to use the current.

5. If the bulb in the test light goes on, then the current is getting to the bulb that is not working. This eliminates the first of the three possible causes. Connect the power supply wire and connect a jumper wire from the bulb to a good metal ground. Do this with the switch which controls the bulb turned ON, and also the ignition switch turned ON required. If the bulb works with jumper wire installed, then the circuit has a bad ground. This is usually caused by the metal area on which the bulb mounts to the truck being coated with some type of foreign matter.

6. If neither test located the source of the trouble, then the

light bulb itself must be defective. You've checked power supply (feed) and power return (ground); if both are good, the load (bulb) must be faulty.

The above test procedure can be applied to any of the components of the chassis electrical system by substituting the component that is not working for the light bulb. Remember that for any electrical system to work, all connections must be clean and tight.

UNDERSTANDING THE ENGINE ELECTRICAL SYSTEM

The engine electrical system can be broken down into three separate and distinct systems:

1. The starting system.
2. The charging system.
3. The ignition system.

Battery and Starting System

The battery is the first link in the chain of items which work together to provide power of the automobile engine. In most modern trucks, the battery is a lead/acid electro-chemical device consisting of six two-volt (2V) subsections connected in series so the unit is capable of producing approximately 12 V of electrical pressure.

Each subsection, or cell, consists of a series of positive and negative plates held a short distance apart in a solution of sulfuric acid and water. The two types of plates are of dissimilar metals. This causes a chemical reaction and it is this reaction which produces current flow from the battery when its positive and negative terminals are connected to an electrical appliance such as a lamp or a motor. The continued transfer of electrons would eventually convert sulfuric acid in the electrolyte to water, and make the two plates identical in chemical composition. As electrical energy is removed from the battery, its voltage output tends to drop. Thus, measuring battery voltage and battery electrolyte composition are two ways of checking the ability of the unit to supply power. During the starting of the engine, electrical energy is removed from the battery. However, if the charging circuit is in good condition and the operating conditions are normal, the power removed from the battery will be replaced by the alternator which will force electrons back through the battery, reversing the normal flow, and restoring the battery to its original chemical state.

NOTE: The battery only stores electrical energy, it does not produce it. The battery can only deliver power equal to what is stored within it. Thus, a low battery may not be able to supply enough power to crank the starter but will still operate the lights, horn and other lower amperage circuits. This should eliminate the famous line, "I know it's not the battery because the radio works..."

The battery and starting motor are linked by very heavy electrical cables designed to minimize resistance to the flow of current. Generally, the major power supply cable that leaves the battery goes directly to the starter, while other electrical needs are supplied by a smaller cable. During the starter operation, power flows from the battery to the starter and is grounded through the truck's frame and the battery's negative ground strap.

The starting motor is a specially designed, direct current electric motor capable of producing a very great amount of power for its size. One thing that allows the motor to produce a great deal of power is its tremendous rotating speed. It drives the engine through a tiny pinion gear (attached to the starter's armature), which drives the very large flywheel ring gear at a greatly

3 ENGINE AND ENGINE OVERHAUL

reduced speed. Another factor allowing it to produce so much power is that only intermittent operation is required of it. Thus, little allowance for air circulation is required, and the windings can be built into a very small space.

The starter solenoid is a magnetic device which employs the small current supplied by the ignition switch. The magnetic action moves a plunger which mechanically engages the starter and electrically closes the heavy switch which connects it to the battery. The starting circuit consists of the starting signal controlled by the ignition switch, a transmission neutral safety switch or clutch pedal switch, and the wiring necessary to connect these with the starter solenoid or relay. Since the circuit has multiple switches, all must be in the ON position for the system to operate.

As soon as the engine starts, the flywheel ring gear begins turning fast enough to drive the pinion at an extremely high rate of speed. At this point, the one-way clutch begins allowing the pinion to spin faster than the starter shaft so that the starter will not operate at excessive speed. (This overrun condition is similar to riding a bicycle downhill; the rear wheel is turning faster than the chain sprocket.) When the ignition switch is released from the starter position, the solenoid is de-energized, and a spring in the solenoid assembly pulls the gear out of mesh and interrupts the current flow to the starter.

Some starters employ a separate relay, mounted away from the starter, to switch the motor and solenoid current on and off. The relay replaces the solenoid electrical switch, but does not eliminate the need for a solenoid mounted on the starter to mechanically engage the starter drive gears. The relay is used to reduce the amount of current the starting switch must carry.

Charging System

The automobile charging system provides electrical power for operation of the vehicle's ignition and all the electrical accessories. The battery serves as an electrical surge or storage tank, storing (in chemical form) the energy originally produced by the engine-driven alternator. The system also provides a means of regulating alternator output to protect the battery from being overcharged and to avoid excessive voltage to the accessories.

The vehicle's alternator is driven mechanically, through belts, by the engine crankshaft. It consists of two coils of fine wire, one stationary (the stator), and one movable (the rotor). The rotor may also be known as the armature, and consists of fine wire wrapped around an iron core which is mounted on a shaft. The electricity which flows through the two coils of wire (provided initially be the battery in some cases) creates an intense magnetic field around both the rotor and stator, and the interaction between the two fields creates voltage, allowing the alternator to power the accessories and charge the battery.

Almost all vehicles today use alternators because they are more efficient, can be rotated at higher speeds, and have fewer brush problems. In an alternator, the field rotates while all the current produced passes only through the stator windings. The brushes bear against continuous slip rings rather than a commutator. This causes the current produced to periodically reverse the direction of its flow, very similar to the power supply to your house. Diodes (electrical one-way switches) block the flow of current from traveling in the wrong direction. A series of diodes is wired together to permit the alternating flow of the stator to be converted to a pulsating, but unidirectional flow at the alternator output. This inverter circuit switches the AC current—unusable by the vehicle—to the standard DC or direct current. The alternator's field is wired in series with the voltage regulator.

The voltage regulator is contained within the alternator. Simply described, it consists of solid-state components whose job it is to limit the output of the alternator to usable levels. Excess output can damage the battery and overvoltage can destroy electrical components.

SAFETY PRECAUTIONS

Observing these precautions will insure safe handling of the electrical systems components and will avoid damage to the vehicle's electrical system:

- Be absolutely sure of the polarity of a booster battery before making connections. Connect the cables positive to positive, and negative to negative. Connect positive cables first and then make the last connection to a ground on the body of the booster vehicle so that arcing cannot ignite hydrogen gas that may have accumulated near the battery. Even momentary connection of a booster battery with the polarity reversed will damage alternator diodes.
- Disconnect both vehicle battery cables before attempting to charge a battery.
- Never ground the alternator. Be cautious when using metal tools around a battery to avoid creating a short circuit between the terminals or from a terminal to ground.
- Never ground the alternator terminals.
- Never run an alternator without load.
- Never attempt to polarize an alternator.

Ignition Coil TESTING

Complete instructions for testing the primary and secondary circuits of the coil are found in Section 2 under Electronic Ignition Diagnosis and Testing.

REMOVAL AND INSTALLATION

- Disconnect the negative battery cable.
- Tag and disconnect all electrical leads at the coil.
- Remove the two mounting bolts and lift off the ignition coil.
- Install the coil in position and tighten the mounting bolts.
- Connect all wires.
- Connect the negative battery cable.

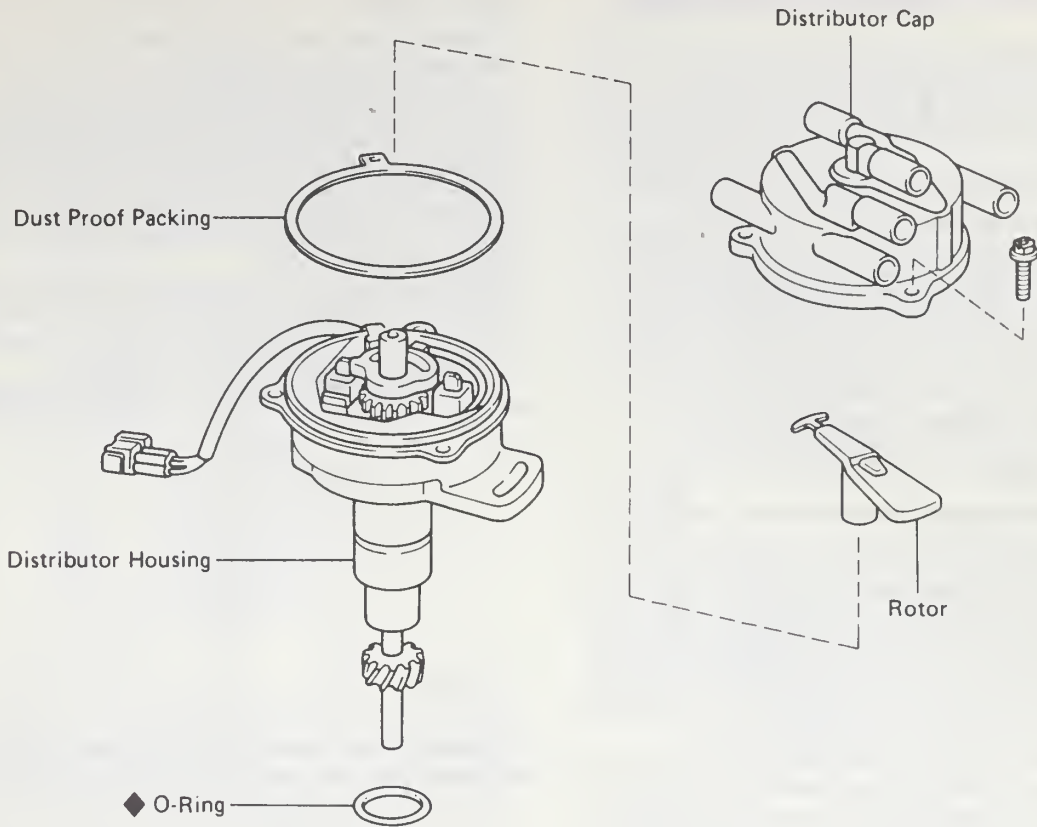
Distributor REMOVAL

On the 22R and 22R-E the distributor is on the left side. On the 3F-E engines, the distributor is located on the right side. To remove the distributor, proceed in the following order:

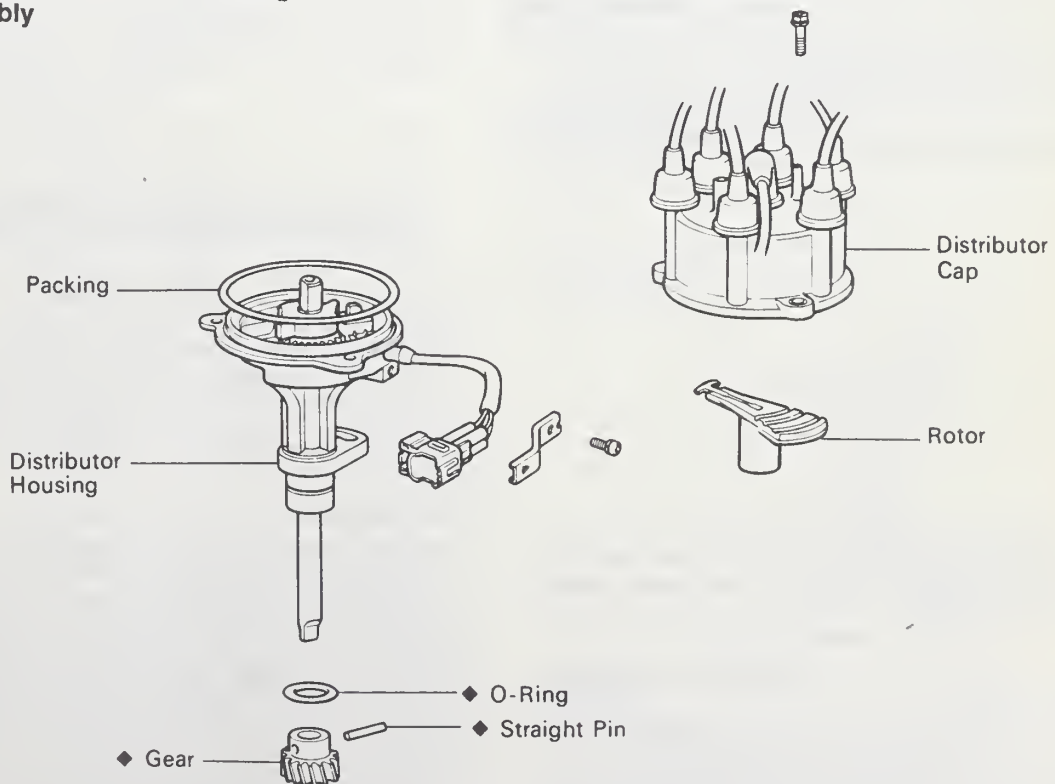
- Unfasten the retaining clips or remove the retaining screws and lift the distributor cap straight off. It will be easier to install the distributor if the wiring is left connected to the cap. If the wires must be removed from the cap, mark their positions to aid in installation.
- Remove the dust cover and mark the position of the rotor relative to the distributor body; then mark the position of the body relative to the block.
- Disconnect the coil wire and the vacuum lines, marking them for installation.

NOTE: An alternate method is to set the engine to TDC, as was done before valve adjustment. For all engines except 22R-E, set the timing mark at 0. On 22R-E, set the timing mark at 5 degrees. This method will also place the distributor in the correct position.

- Remove the pinch-bolt and lift the distributor straight out, away from the engine. The rotor and body are marked so that they can be returned to the position from which they were removed. Do not turn or disturb the engine (unless absolutely necessary, such as for engine rebuilding), after the distributor has been removed. The relationship between the position of the distributor and the position of the engine is critical if the spark is to be sent to the proper place at the proper time.



Distributor components – 3VZ-E engine. Items marked with the black diamond should always be replaced before assembly



Distributor components – 3F-E engine

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INSTALLATION—TIMING NOT DISTURBED

1. Align the matchmarks on the distributor with the rotor; position the distributor to align with the mark made on the block. Insert the distributor in the block, taking care not to damage the drive gear at the bottom or to knock all the marks out of alignment.

2. Engage the distributor driven gear with the distributor drive.

3. Install the distributor clamp and secure it with the pinch-bolt.

4. Install the cap, primary wire, and vacuum line(s).

5. Install the spark plug leads and the coil wire. Consult the marks made during removal to be sure that the proper lead goes to each plug.

6. Start the engine. Check the timing and adjust it.

INSTALLATION—TIMING LOST

22R and 22R-E Engine

If the engine has been cranked, dismantled, or the timing otherwise lost, proceed as follows:

1. Determine top dead center (TDC) of the No. 1 cylinder's compression stroke by removing the spark plug from the No. 1 cylinder and placing your finger over the spark plug hole. Turn the engine clockwise (with a wrench on the crank pulley bolt) until the timing marks align at 0 (22R) or 5° (22R-E) AND definite compression can be felt pressing against your finger. Doing this important; the timing marks also align at 0 during the exhaust stroke, but no compression will be felt.

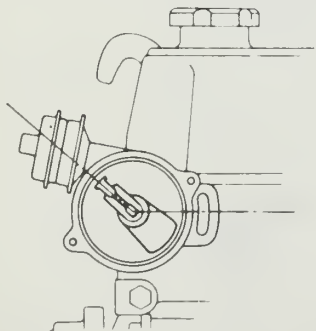
2. On engines which have the spark plugs buried into the manifold, use a compression gauge or a screwdriver handle, not your finger, to sense compression.

3. If possible, remove the oil filler cap and check the No. 1 valve rockers through the hole; they should be loose.

4. Temporarily install the rotor.

5. Slowly insert the distributor into the cylinder block. The rotor should be pointing upward; the distributor mounting hole in the block should be approximately at the center position of the elongated bolt hole on the distributor.

6. As the distributor is fully seated, the rotor will rotate to the position shown in the illustration. Note that the slotted bolt hole on the distributor is still centered over the bolt hole in the engine.



22R and 22R-E distributor rotor will move into this position after installation. Before installation, position it pointing straight up

7. Remove the rotor and the dust cap. Install the pinch-bolt and tighten it slightly.

8. Align one of the 4 teeth on the signal rotor with the small projection on the signal generator (pick-up coil).

9. Tighten the pinch-bolt to 14 ft. lbs. (19 Nm).

10. Install the dust cover and the rotor. Replace the distributor cap and wires and check the ignition timing.

3VZ-E Engines

If the engine has been cranked, dismantled, or the timing otherwise lost, proceed as follows:

1. Determine top dead center (TDC) of the No. 1 cylinder's compression stroke by removing the spark plug from the No. 1 cylinder and placing your finger over the spark plug hole. Turn the engine clockwise (with a wrench on the crank pulley bolt) until the timing marks align at 0 AND definite compression can be felt pressing against your finger. Doing this important; the timing marks also align at 0 during the exhaust stroke, but no compression will be felt.

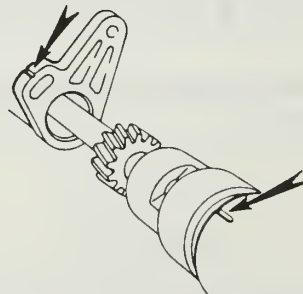
2. On engines which have the spark plugs buried into the manifold, use a compression gauge or a screwdriver handle, not your finger, to sense compression.

3. Replace the distributor shaft O-ring.

4. Align the protrusion on the distributor driven gear with the groove on the lower edge of the distributor housing.



On 3VZ-E distributors, align the small protrusion with the groove on the housing before installation



When installing the 3VZ-E distributor, align the distributor mark with the mark on the engine

5. Insert the distributor into the hole so that the groove on the lower edge of the distributor housing is in alignment with the groove on the No. 4 camshaft bearing cap.

6. Lightly tighten the distributor hold-down bolts.

7. Install the dust proof packing and then the distributor cap.

8. Connect the distributor line and the high tension wires to the cap.

9. Run the engine until it reaches normal operating temperature and then check the ignition timing.

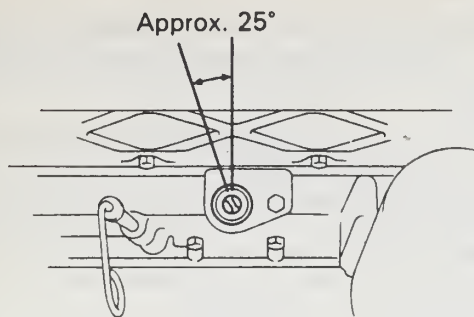
3F-E Engines

If the engine has been cranked, dismantled, or the timing otherwise lost, proceed as follows:

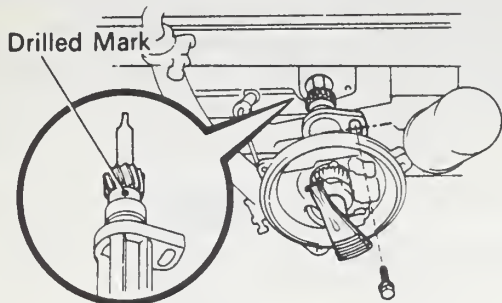
1. Determine top dead center (TDC) of the No. 1 cylinder's compression stroke by removing the spark plug from the No. 1 cylinder and placing your finger over the spark plug hole.

2. Turn the engine clockwise (with a wrench on the crank pulley bolt) until the timing marks align at 0 AND definite compression can be felt pressing against your finger. Doing this is important; the timing marks also align at 0 during the exhaust stroke, but no compression will be felt.

3. Look into the hole that the distributor will fit into in the engine. The slotted oil pump shaft must be positioned so that it



Correct position of the oil pump drive shaft before distributor installation — 3F-E



The dot faces upwards and the slotted adjustment hole is centered during 3F-E distributor installation

is in roughly the 11 o'clock/5 o'clock position. If not, gently turn the engine clockwise with the wrench on the crank pulley until it is. (If Step 1 was done correctly, it won't need much adjustment.) Don't attempt to turn it with a screwdriver.

4. Lightly coat a new O-ring with engine oil and then install it onto the distributor shaft.

5. The distributor has a dot or drilled mark on it which must face upward at installation. With the distributor correctly positioned, insert the distributor into its hole so that the center of the slotted adjustment flange aligns with center of the bolt hole in the cylinder head.

6. When the distributor is fully inserted, the rotor should be pointing in the direction shown.

7. Lightly tighten the distributor hold-down bolt and then install the distributor cap and all the wires.

8. Run the engine until it reaches normal operating temperature and then check the ignition timing.

Alternator

The alternator converts the mechanical energy supplied by the drive belt into electrical energy by a process of electromagnetic induction. When the ignition switch is turned on, current flows from the battery through the charging system light warning lamp on the dashboard to the voltage regulator, and finally to the alternator.

When the engine is started, the drive belt turns the rotating field (rotor) inside the stationary windings (stator), inducing alternating current. This alternating current is converted into usable direct current by the diode rectifier. Most of this current is used to charge the battery and to supply power for the vehicle's electrical accessories. A small part of this current is returned to the field windings of the alternator enabling it to increase its power output. When the current in the field windings reaches a predetermined level, the voltage regulator grounds the circuit preventing any further increase. The cycle is continued so that the voltage supply remains constant.

All current trucks use a nominal 12 volt alternator. (Exact output should be slightly higher, generally 13.5–14.4 volts). Amperage ratings may vary according to the year, model and acces-

sories. All have a transistorized, non-adjustable regulator, integrated with the alternator.

ALTERNATOR PRECAUTIONS

To prevent damage to the alternator and regulator, the following precautionary measures must be taken when working with the electrical system.

1. Never reverse the battery connections. Always check the battery polarity visually. This is to be done before any connections are made to ensure that all of the connections correspond to the battery ground polarity of the truck.

2. Booster batteries must be connected properly. Make sure the positive cable of the booster battery is connected to the positive terminal of the battery which is getting the boost.

3. Disconnect the battery cables before using a fast charger; the charger has a tendency to force current through the diodes in the opposite direction. This causes damage.

4. Never use a fast charger as a booster for starting the truck.

5. Never disconnect the voltage regulator while the engine is running.

6. Do not ground the alternator output terminal.

7. Do not operate the alternator on an open circuit with the field energized.

8. Do not attempt to polarize the alternator.

9. Disconnect the battery cables and remove the alternator before using an electric arc welder on the truck.

10. Protect the alternator from excessive moisture. If the engine is to be steam cleaned, cover or remove the alternator.

REMOVAL AND INSTALLATION

NOTE: On some models, the alternator is mounted very low on the engine. On these models, it may be necessary to remove the gravel shield and work from beneath the truck in order to gain access to the alternator.

3VZ-E and 3F-E Engines

1. Disconnect the negative battery cable.

2. Disconnect the wiring connector at the back of the alternator. Lift the rubber boot, remove the nut from the external terminal and remove the wire.

3. Loosen the alternator pivot bolt and loosen the upper lock nut.

4. Push the alternator towards the engine and remove the belt.

5. Remove the pivot and adjusting bolts. On 3F-E, remove the nuts and bolts holding the air pump support, then remove the adjusting bar and its bolts.



3F-E alternator connectors

6. Remove the alternator.

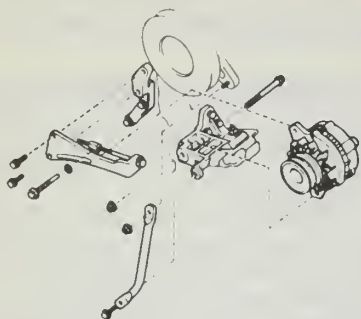
To install:

7. Place the alternator in position and loosely install the pivot and adjusting bolts.

8. On 3F-E, install the adjusting bar and its 2 bolts. Set the nuts and bolts just snug. Install the air pump support.

9. Install the drive belt; adjust it to the proper tension, tight-

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Air pump stay and adjusting bar assembly on 3F-E alternator

ening the adjusting and pivot bolts. Tighten the 3F-E adjuster bar bolts.

10. Connect the wire to the terminal and install the nut. Fit the rubber boot over the terminal. Attach the plastic wire harness connector.

11. Connect the negative battery cable.

22R and 22R-E Engines

1. Disconnect the negative battery terminal.

2. If the vehicle is equipped with power steering, drain the coolant from the system.

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

3. Disconnect the wiring connector at the back of the alternator. Lift the rubber boot, remove the nut from the external terminal and remove the wire.

4. If equipped with power steering, remove the engine splash shield or undercover, then remove the water inlet pipe.

5. If the truck has air conditioning, remove the No.2 (lower) fan shroud.

6. Loosen the pivot bolt and remove the adjusting bolt.

7. Push the alternator towards the engine and remove the belt.

8. Hold the alternator; remove the pivot bolt. Remove the alternator.

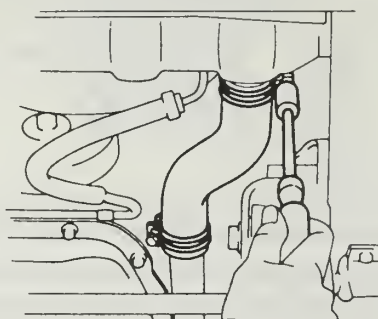
To install:

9. Mount the alternator on its bracket; install the pivot and adjusting bolts.

10. Install the drive belt and adjust it correctly. Tighten the pivot and adjusting bolts.

11. Install the water inlet hose if it was removed. Install the fan shroud and install the engine splash shield.

12. Connect the wire to the terminal; install the nut and secure the rubber boot. Attach the wire harness connector to the alternator.



Removing the water Inlet pipe, 22R and 22R-E

Troubleshooting Basic Charging System Problems

Problem	Cause	Solution
Noisy alternator	- Loose mountings - Loose drive pulley - Worn bearings - Brush noise - Internal circuits shorted (High pitched whine)	- Tighten mounting bolts - Tighten pulley - Replace alternator - Replace alternator - Replace alternator
Squeal when starting engine or accelerating	Glazed or loose belt	Replace or adjust belt
Indicator light remains on or ammeter indicates discharge (engine running)	- Broken fan belt - Broken or disconnected wires - Internal alternator problems - Defective voltage regulator	- Install belt - Repair or connect wiring - Replace alternator - Replace voltage regulator
Car light bulbs continually burn out—battery needs water continually	Alternator/regulator overcharging	Replace voltage regulator/alternator
Car lights flare on acceleration	- Battery low - Internal alternator/regulator problems	- Charge or replace battery - Replace alternator/regulator
Low voltage output (alternator light flickers continually or ammeter needle wanders)	- Loose or worn belt - Dirty or corroded connections - Internal alternator/regulator problems	- Replace or adjust belt - Clean or replace connections - Replace alternator or regulator

13. Close the radiator drain cock and refill the system with coolant.
14. Connect the negative battery cable.

Regulator

All regulators are contained inside the case of the alternator and are not replaceable as a maintenance item. Solid-state regulators rarely fail and should not be considered ahead of other possible causes when diagnosing charging system problems.

Battery

Refer to Section 1 for details on battery maintenance.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable from the terminal, then disconnect the positive cable. Special pliers and pullers are available to remove the clamps. Be careful of the many wires and fittings on and around the positive terminal.

NOTE: To avoid sparks, always disconnect the negative cable first and reconnect it last.

2. Unscrew and remove the battery hold down clamp.
3. Remove the battery, being careful not to spill any of the acid.

NOTE: Spilled acid can be neutralized with a baking soda and water solution. If you somehow get acid into your eyes, flush it out with lots of clean water and get to a doctor as quickly as possible.

4. Clean the battery posts thoroughly before reinstalling or when installing a new one. A light coating of petroleum jelly or battery terminal spray protectant will help fight corrosion.
5. Clean the cable clamps using the special tools or a wire brush, both inside and out.
6. Install the battery, and the hold down clamp. Connect the positive and then the negative cable. Do not hammer them into place. The terminals should be coated with grease to prevent corrosion.

CAUTION

Make absolutely sure that the battery is connected properly before you turn on the ignition switch. Reversed polarity can burn out an alternator in a matter of seconds.

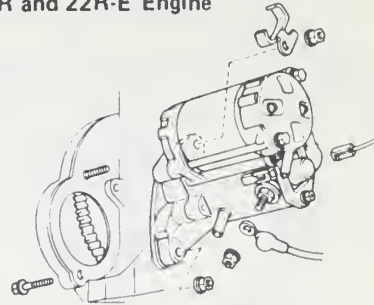
Starter

REMOVAL AND INSTALLATION

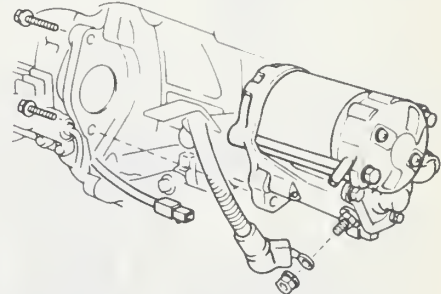
NOTE: The starter may be hot if the engine was recently run. Be careful of surrounding hot components. Whether hot or cold, the starter is relatively heavy for its size—be prepared when you remove it.

1. Disconnect the negative battery cable. Disconnect the positive battery cable at the starter.
2. Disconnect the remaining electrical connections at the starter solenoid.
3. Remove the nuts and/or bolts holding the starter to the bell housing and pull the starter toward the front of the vehicle.
4. To install the unit, insert the starter into the bell housing

22R and 22R-E Engine



3VZ-E Engine



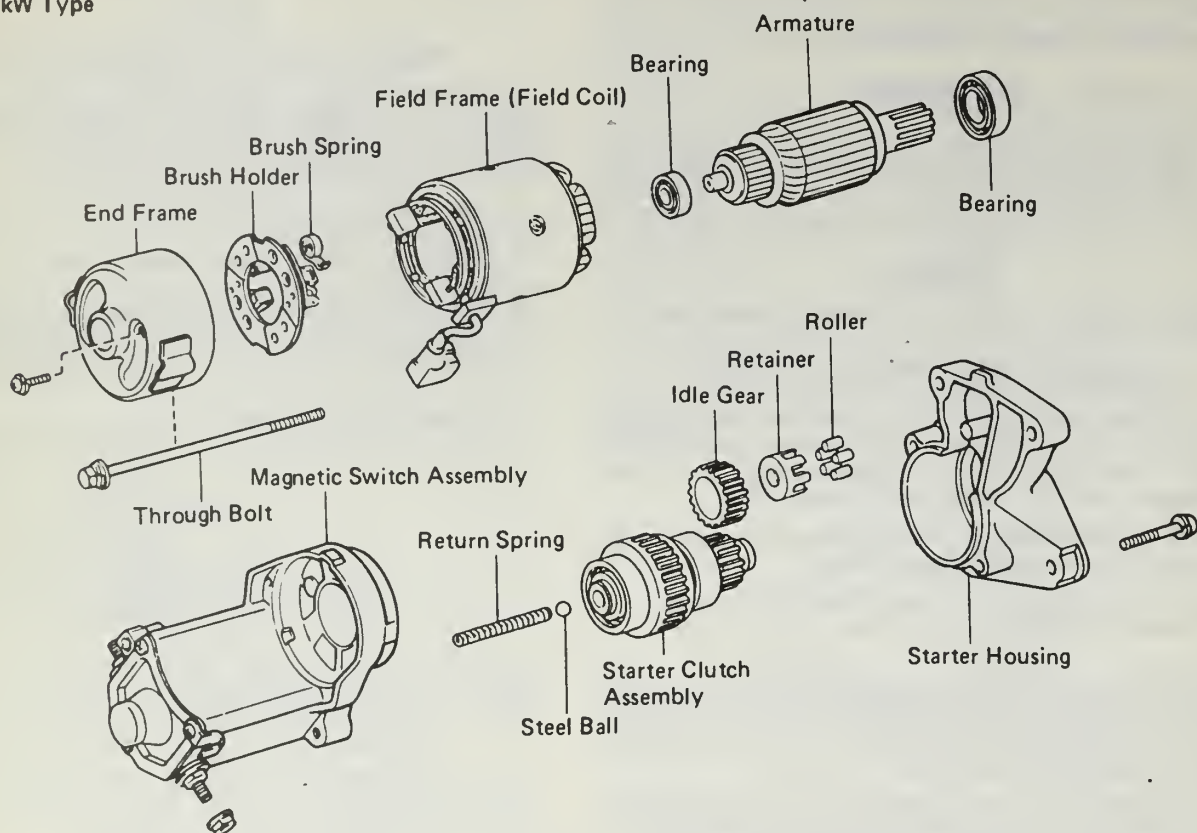
Starter removal; 3F-E similar

ALTERNATOR AND REGULATOR SPECIFICATIONS

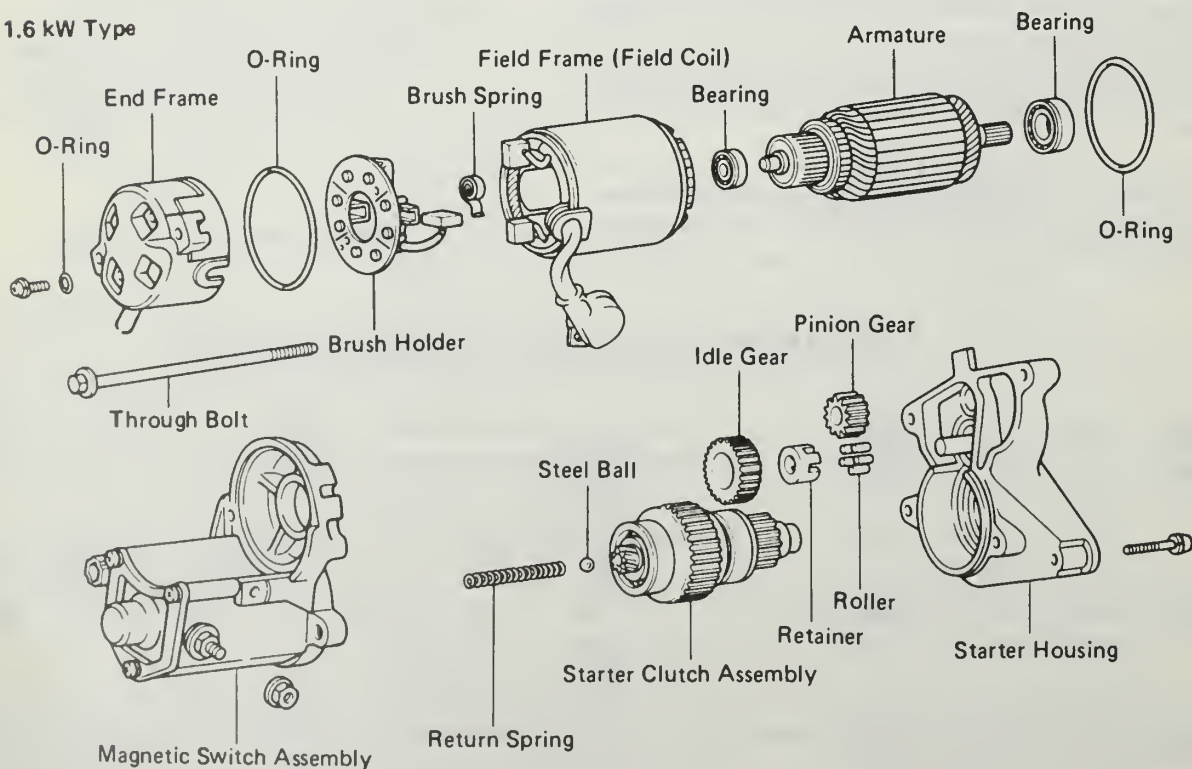
Years	Models	Engine	Output (amps)	Regulated Volts @ 75°F
1989	Truck	22R	60	13.9–15.1
		22RE		
		3VZ-E	60	13.9–15.1
		3F-E	80	13.8–14.4
1990	Truck	22R	70	13.9–15.1
		22R-E		
		3VZ-E	60	13.9–15.1
		3F-E	80	13.8–14.4
1991	All	22R-E	60	13.9–15.1
		3VZ-E	60	13.9–15.1
		3F-E	80	13.8–14.4

3 ENGINE AND ENGINE OVERHAUL

1.0 kW Type



1.4, 1.6 kW Type



Starter components — 22R, 22R-E and 3VZ-E

being sure that the starter drive teeth are engaged with the flywheel teeth, not jammed against the flywheel.

5. Tighten the attaching hardware to 29 ft. lbs. (39 Nm) and replace all electrical connections.

6. Connect the positive battery cable at the starter. Connect the negative battery cable.

OVERHAUL

1. Remove the starter. The starter may be 1000 watt (1kW), 1400 watt (1.4 Kw) or 1600 watt (1.6 kW) type.

2. On the workbench, disconnect the wire from the solenoid terminal.

3. Remove the two long through bolts. Pull out the field frame with the armature. On 1.4 and 1.6 kW starters, remove the O-ring.

4. Remove the two screws from the solenoid and remove the starter housing. On 1.4 and 1.6 kW units, the pinion gear, idler gear, bearing and clutch assembly will also come off.

5. Remove the clutch assembly and gears from the starter housing.

6. Use a small magnet to remove the steel ball and spring from the clutch shaft hole.

7. Remove the two screws and remove the endcover off the field frame.

8. Use a small, flat tool to hold the spring back; disconnect the brush from the brush holder. Remove the 4 brushes and remove the brush holders.

9. Remove the armature from the field frame.

10. Inspect the components:

a. Use an ohmmeter to check the rotor (commutator). There should be no continuity between the rotor and coil core.

b. There should be continuity between each segment of the end of the rotor.

c. Inspect the rotor for dirt or burnt spots. If any are found, the surface may be cleaned with very fine sand paper. Do not rub so hard that scratches are made or the diameter is reduced.

d. Use calipers or other precision measuring device, inspect the diameter of the commutator. New diameter is 1.18 in. (30mm); minimum diameter limit is 1.14 in. or 29mm.

e. Test continuity on the field frame (stator). There should be continuity between the wire terminal and the field coil brush lead. There should be no continuity between the brush lead and the case of the stator.

f. Measure the brush length. Minimum length is 0.335 in. (8.5mm) for 1 Kw starters and 0.394 in. (10mm) for 1.4 Kw and 1.6 Kw starters.

g. Check that there is no continuity between the positive and negative brush holders.

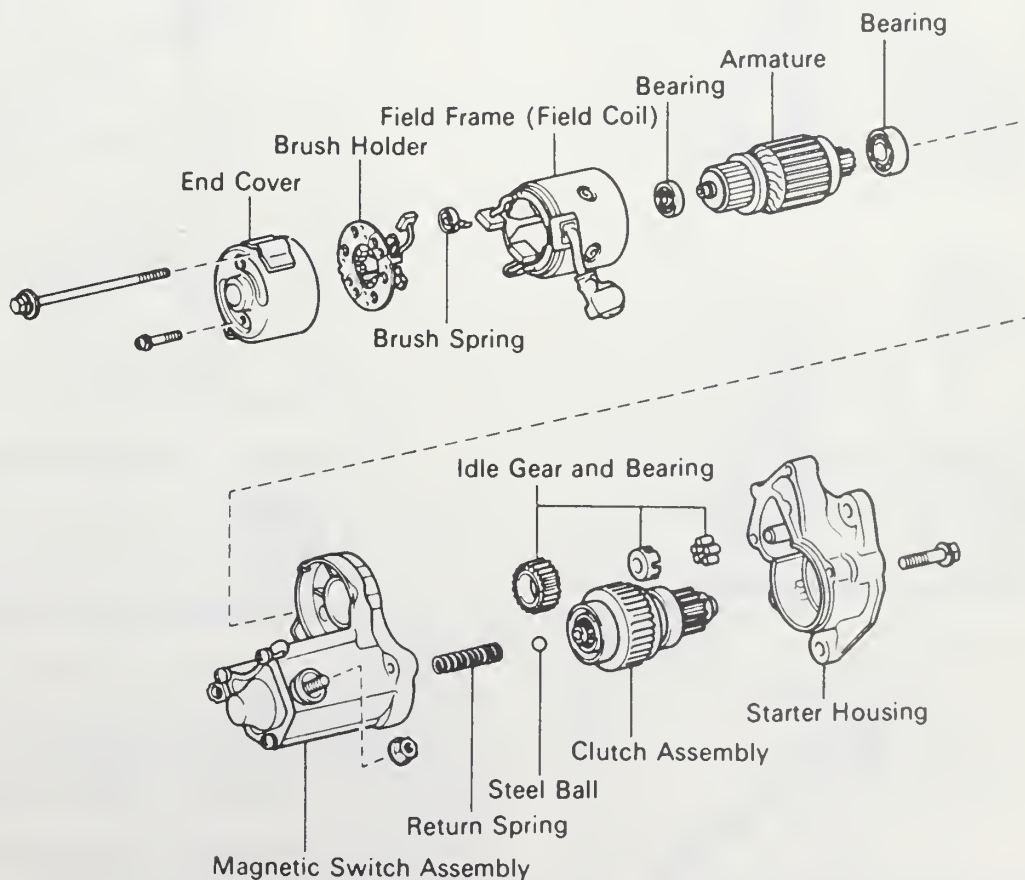
h. Inspect the teeth on all the gears for any chipping or damage.

i. Inspect the clutch pinion gear. Turn it clockwise; it should turn freely with no binding. It should lock and not turn at all when you attempt to turn it counterclockwise.

j. Check the bearings. Push inward and turn the bearing. It should spin with no resistance or grinding.

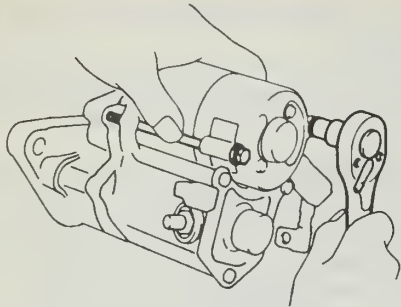
k. Check the solenoid (magnetic switch). There should be electrical continuity between the two terminals but not between Terminal 50 and the case.

l. All test conditions must be met. If any component or assembly fails any test, that component or assembly must be replaced.

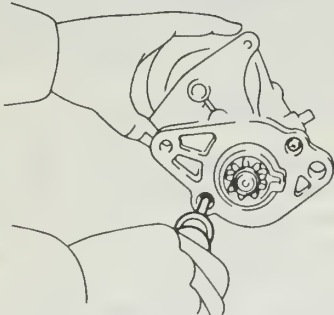


Starter components — 3F-E engine

3 ENGINE AND ENGINE OVERHAUL

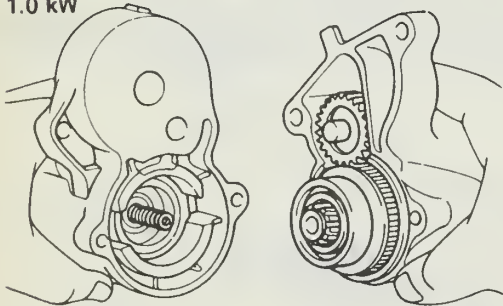


Remove the through bolts

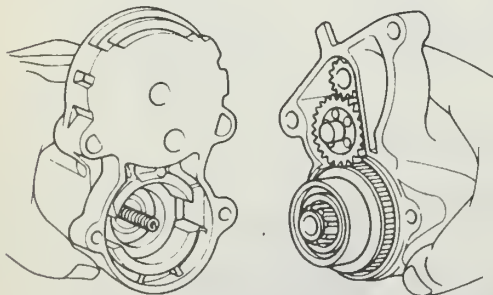


Removing the starter housing

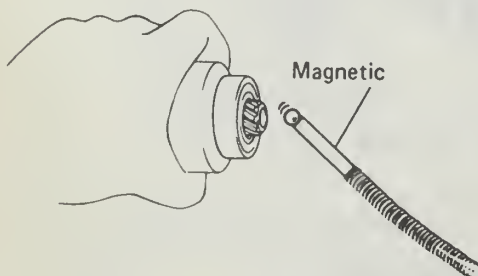
1.0 kW



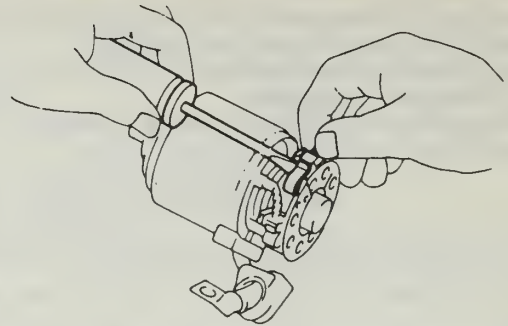
1.4 kW, 1.6 kW



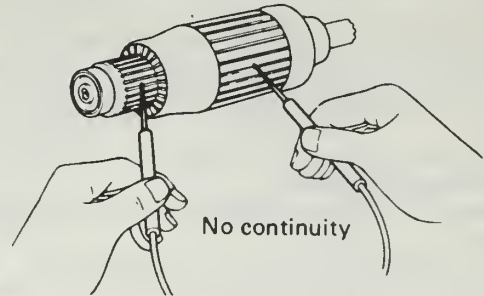
Removing the starter drive



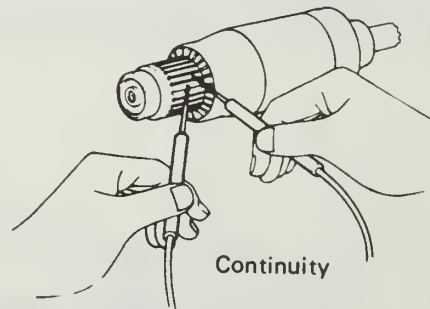
Don't lose the steel ball



Lift and hold the brush holder during brush removal

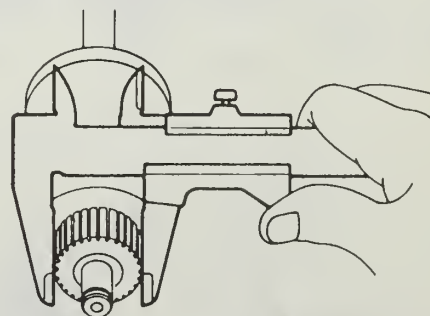


No continuity



Continuity

Testing the commutator



Accurate measuring is required

To install:

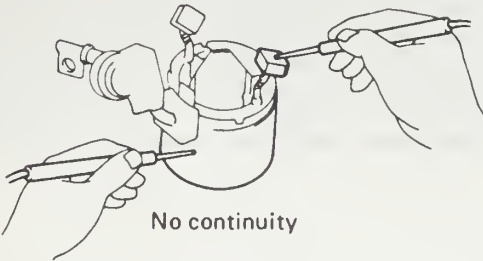
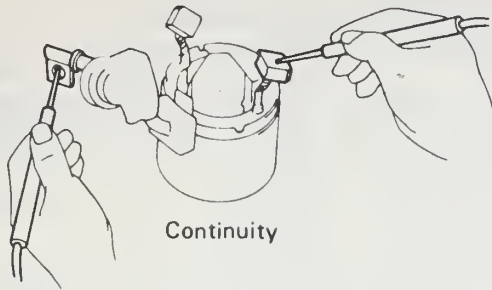
11. Use high temperature grease to lubricate the bearings and gears during assembly.

12. Insert the armature into the field frame.

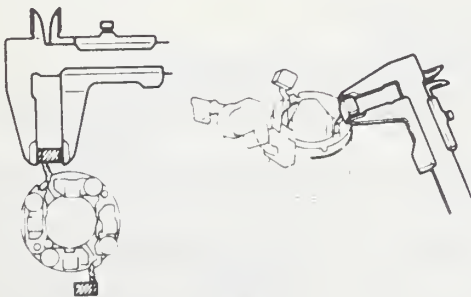
13. Place the brush holder over the frame. Use a small, flat tool to hold the brush spring back and install the brushes into the holders. Check that the positive brush wires are not grounded.

14. For 1.4 Kw and 1.6 Kw starters, install the O-ring on the frame. Install the end cover onto the unit.

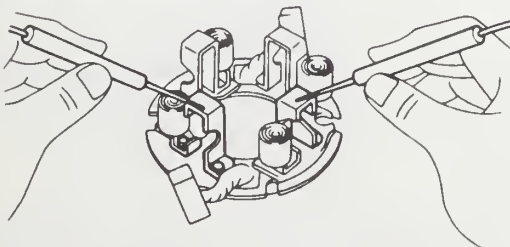
15. Lubricate the steel ball and install it into the clutch shaft hole.



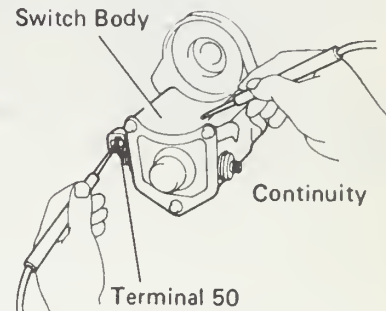
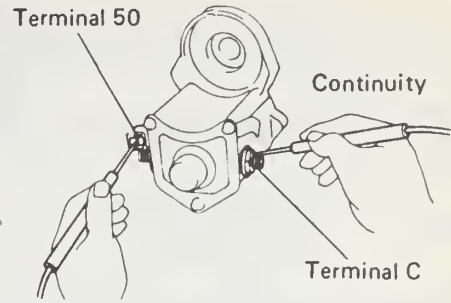
Checking the field frame for shorts and open circuits



Always check the brush length

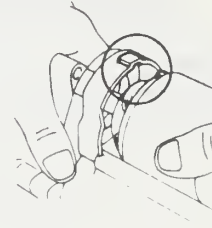


Check the brush holders for shorting



Inspecting the solenoid for shorts and open circuits

1.0 kW



1.4 kW, 1.6 kW



Aligning the solenoid with the starter case

16. Assemble the clutch assembly into the starter housing.

17. Place the return spring into the hole. Install the starter housing onto the solenoid and install the two screws.

18. Mate the solenoid unit to the starter, making sure the

notch and groove align. Don't forget the O-ring if one was removed.

19. Install the 2 through bolts. Connect the wire lead to Terminal C and install the nut.

20. Reinstall the starter.

STARTER SPECIFICATIONS

Years	Engine	No-Load Test			Brush Spring Tension
		Max. Amps	Max. Volts	Min. RPM	
1989	22R	90	11.5	3000 ①	3.9–5.3 lbs.
	22R-E			3500 ②	
	3VZ-E	90	11.5	3000 ①	3.9–5.3 lbs.
	3F-E			3500 ②	
		90	11.5	3000	3.9–5.3 lbs.

3 ENGINE AND ENGINE OVERHAUL

STARTER SPECIFICATIONS

Years	Engine	No-Load Test		Min. RPM	Brush Spring Tension
		Max. Amps	Max. Volts		
1990	22R-E	90	11.5	3000 ① 3500 ②	3.9-5.3 lbs.
	3VZ-E	90	11.5	3000 ① 3500 ②	3.9-5.3 lbs.
	3F-E	90	11.5	3000	3.9-5.3 lbs.
1991	22R-E	90	11.5	3000 ① 3500 ②	3.9-5.3 lbs.
	3VZ-E	90	11.5	3000 ① 3500 ②	3.9-5.3 lbs.
	3F-E	90	11.5	3000	3.9-5.3 lbs.

① 1 KW Starter

② 1.4 KW Starter or 1.6 KW Starter

Troubleshooting Basic Starting System Problems

Problem	Cause	Solution
Starter motor rotates engine slowly	- Battery charge low or battery defective - Defective circuit between battery and starter motor - Low load current - High load current	- Charge or replace battery - Clean and tighten, or replace cables - Bench-test starter motor. Inspect for worn brushes and weak brush springs. - Bench-test starter motor. Check engine for friction, drag or coolant in cylinders. Check ring gear-to-pinion gear clearance.
Starter motor will not rotate engine	- Battery charge low or battery defective - Faulty solenoid - Damage drive pinion gear or ring gear - Starter motor engagement weak - Starter motor rotates slowly with high load current - Engine seized	- Charge or replace battery - Check solenoid ground. Repair or replace as necessary. - Replace damaged gear(s) - Bench-test starter motor - Inspect drive yoke pull-down and point gap, check for worn end bushings, check ring gear clearance - Repair engine
Starter motor drive will not engage (solenoid known to be good)	- Defective contact point assembly - Inadequate contact point assembly ground - Defective hold-in coil	- Repair or replace contact point assembly - Repair connection at ground screw - Replace field winding assembly

Troubleshooting Basic Starting System Problems

Problem	Cause	Solution
Starter motor drive will not disengage	• Starter motor loose on flywheel housing	• Tighten mounting bolts
	• Worn drive end busing	• Replace bushing
	• Damaged ring gear teeth	• Replace ring gear or driveplate
	• Drive yoke return spring broken or missing	• Replace spring
Starter motor drive disengages prematurely	• Weak drive assembly thrust spring	• Replace drive mechanism
	• Hold-in coil defective	• Replace field winding assembly
Low load current	• Worn brushes	• Replace brushes
	• Weak brush springs	• Replace springs

ENGINE MECHANICAL

Understanding the Engine

The piston engine is a metal block containing a series of round chambers or cylinders. These chambers may be arranged in line or in a V; hence, the description of an engine as an inline 4- or 6-cylinder or a V6 or V8. The upper part of the engine block is usually an iron or aluminum-alloy casting. The casting forms outer walls around the cylinders with hollow areas in between, through which coolant circulates. The lower block provides a number of rigid mounting points for the crankshaft and its bearings. The lower block is referred to as the crankcase.

The crankshaft is a long, steel shaft mounted at the bottom of the engine and free to turn in its mounts. The mounting points (generally four to seven) and the bearings for the crankshaft are called main bearings. The crankshaft is the shaft which is made to turn through the function of the engine; this motion is then passed into the transmission/transaxle and on to the drive wheels.

Attached to the crankshaft are the connecting rods which run up to the pistons within the cylinders. As the air/fuel mixture explodes within the tightly sealed cylinder, the piston is forced downward. This motion is transferred through the connecting rod to the crankshaft and the shaft turns. As one piston finishes its power stroke, its next upward journey forces the burnt gases out of the cylinder through the now-open exhaust valve. By the top of the stroke, the exhaust valve has closed and the intake valve has begun to open, allowing the fresh air/fuel charge to be sucked into the cylinder by the downward stroke of the piston. The intake valve closes, the piston once again comes back up and compresses the charge in the closed cylinder. At the top (approximately) of this stroke the spark plug fires, the charge explodes and another power stroke takes place. If you count the piston motions in between power strokes, you'll see why automotive engines are called four-stroke or four-cycle engines.

While one cylinder is performing this cycle, all the others are also contributing; but in different timing. Obviously, all the cylinders cannot fire at once or the power flow would not be steady. As any one cylinder is on its power stroke, another is on its exhaust stroke, another on intake and another on compression. These constant power pulses keep the crank turning; a large

round flywheel attached to the end of the crankshaft provides a stable mass to smooth out the rotation.

At the top of the engine, the cylinder head(s) provide tight covers for the cylinders. They contain machined chambers into which the fuel charge is forced as the piston reaches the top of its travel. These combustion chambers contain at least one intake and one exhaust valve which are opened and closed through the action of the camshaft. The spark plugs are screwed into the cylinder head so that the tips of the plugs protrude into the chamber.

Since the timing of the valve action (opening and closing) is critical to the combustion process, the camshaft is driven by a belt or chain. The valves are operated either by pushrods (called overhead valves—the valves are above the cam) or by the direct action of the cam pushing on the valves (overhead cam). Toyota trucks with either the 4 cylinder or V6 engines use overhead cam (OHC) engines. The Land Cruiser 3F-E engine is a pushrod or overhead valve engine.

Lubricating oil is stored in a pan or sump at the bottom of the engine. It is force fed to all the parts of the engine by the oil pump which may be driven by either the crank or the camshaft. The oil lubricates the entire engine by travelling through passages in the block and head. Additionally, the circulation of the oil provides 25–40% of the engine cooling.

If all this seems very complicated, keep in mind that the sole purpose of any motor—gas, diesel, electric, solar—is to turn a shaft. The motion of the shaft is then harnessed to perform a task such as pumping water, moving the vehicle, etc. Due to the constantly changing operating conditions found in a motor vehicle, accomplishing this shaft-turning in an automotive engine requires many supporting systems such as fuel delivery, exhaust handling, lubrication, cooling, starting, etc. Operation of these systems involve principles of mechanics, vacuum, electronics, etc. Being able to identify a problem by what system is involved will allow you to begin accurate diagnosis of the symptoms and causes.

Engine Overhaul Tips

Most engine overhaul procedures are fairly standard. In addition to specific parts replacement procedures and complete

3 ENGINE AND ENGINE OVERHAUL

specifications for your individual engine, this Section also is a guide to accepted rebuilding procedures. Examples of standard rebuilding practice are shown and should be used along with specific details concerning your particular engine.

Competent and accurate machine shop services will ensure maximum performance, reliability and engine life.

In most instances it is more profitable for the do-it-yourself mechanic to remove, clean and inspect the component, buy the necessary parts and deliver these to a shop for actual machine work.

On the other hand, much of the rebuilding work (crankshaft, block, bearings, piston rods, and other replaceable components) is well within the scope of the do-it-yourself mechanic. Patience, proper tools, and common sense coupled with a basic understanding of the motor can yield satisfying and economical results.

TOOLS

The tools required for an engine overhaul or parts replacement will depend on the depth of your involvement. With a few exceptions, they will be the tools found in a mechanic's tool kit (see Section 1). More in-depth work will require any or all of the following:

- A dial indicator (reading in thousandths of an inch or metric equivalent) mounted on a universal base. The base may or may not come with a new unit.

- Micrometers and telescope gauges
- Jaw and screw-type pullers
- Gasket scrapers; the best are wood or plastic
- Valve spring compressor
- Ring groove cleaner
- Piston ring expander and compressor
- Ridge reamer
- Cylinder hone or glaze breaker
- Plastigage®

- Engine stand. This single tool may be the most expensive piece of equipment in your garage but is well worth the cost. The engine can be bolted to it and then rotated into any position for work on the upper or lower end.

- Engine hoist or crane. Generally not worth the high cost of purchase unless you plan to remove engines on a regular basis, these units can be rented from many supply houses. Engine hoists are superior to overhead chain lifts because the casted lift can be repositioned instead of moving the vehicle.

The use of most of these tools is illustrated in this Section. Many can be rented for a one-time use from a local parts jobber or tool supply house specializing in automotive work.

Occasionally, the use of special tools is called for. See the information on Special Tools and Safety Notice in the front of this book before substituting another tool.

INSPECTION TECHNIQUES

Procedures and specifications are given in this chapter for inspecting, cleaning and assessing the wear limits of most major components. Other procedures such as MagnaFlux® and Zyglo® can be used to locate material flaws and stress cracks. MagnaFlux® is a magnetic process applicable only to ferrous (iron and steel) materials. The Zyglo® process coats the material with a fluorescent dye penetrant and can be used on any material. Checks for suspected surface cracks can be more readily made using spot check dye. The dye is sprayed onto the suspected area, wiped off and the area sprayed with a developer. Cracks will show up brightly.

OVERHAUL TIPS

Aluminum has become extremely popular for use in engines, due to its low weight. Observe the following precautions when handling aluminum parts:

- Never hot tank aluminum parts (the caustic hot tank solution will eat the aluminum.)

- Remove all aluminum parts (identification tag, etc.) from engine parts prior to the tanking.

- Always coat threads lightly with engine oil or anti-seize compounds before installation to prevent seizure.

- Never overtighten bolts or spark plugs especially in aluminum threads.

Stripped threads in any component can be repaired using any of several commercial repair kits (Heli-Coil®, Microdot®, Keenserts®, etc.).

When assembling the engine, any parts that will be in frictional contact must be prelubed to provide lubrication at initial start-up. Any product specifically formulated for this purpose can be used, but engine oil is not recommended as a prelude.

When semi-permanent (locked, but removable) installation of bolts or nuts is desired, threads should be cleaned and coated with Loctite® or other similar, commercial non-hardening sealant.

REPAIRING DAMAGED THREADS

Several methods of repairing damaged threads are available. Heli-Coil® (shown here), Keenserts® and Microdot® are among the most widely used. All involve basically the same principle—drilling out stripped threads, tapping the hole and installing a prewound insert—making welding, plugging and oversize fasteners unnecessary.

Two types of thread repair inserts are usually supplied: a standard type for most Inch Coarse, Inch Fine, Metric Course and Metric Fine thread sizes and a spark plug type to fit most spark plug port sizes. Consult the individual manufacturer's catalog to determine exact applications. Typical thread repair kits will contain a selection of prewound threaded inserts, a tap (corresponding to the outside diameter threads of the insert) and an installation tool. Spark plug inserts usually differ because they require a tap equipped with pilot threads and a combined reamer/tap section. Most manufacturers also supply blister-packed thread repair inserts separately in addition to a master kit containing a variety of taps and inserts plus installation tools.

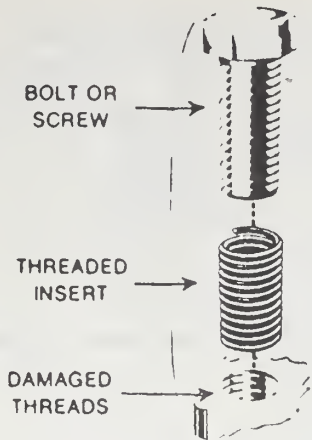
Before effecting a repair to a threaded hole, remove any snapped, broken or damaged bolts or studs. Penetrating oil can be used to free frozen threads. The offending item can usually be removed with locking pliers or with a screw or stud extractor without drilling. After the hole is clear, the thread can be repaired, as shown in the series of accompanying illustrations.

Checking Engine Compression

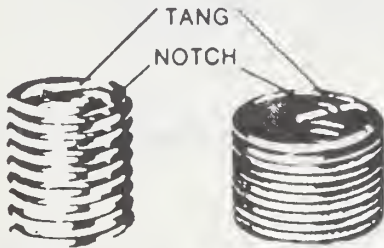
A noticeable lack of engine power, excessive oil consumption and/or poor fuel mileage measured over an extended period are all indicators of internal engine wear. Worn piston rings, scored or worn cylinder bores, leaking head gaskets, sticking or burnt valves and worn valve seats are all possible culprits here. A check of each cylinder's compression will help you locate the problems.

As mentioned in the Tools and Equipment part of Section 1, a screw-in type compression gauge is more accurate than the type you simply hold against the spark plug hole, although it takes slightly longer to use. It's worth it to obtain a more accurate reading. Follow the procedures below.

1. Warm up the engine to normal operating temperature.
2. Remove all the spark plugs.
3. Disconnect the high tension lead (coil wire) from the ignition coil.
4. Fully open the throttle either by operating the carburetor throttle linkage by hand or by having an assistant floor the accelerator pedal.
5. Screw the compression gauge into the no.1 spark plug hole until the fitting is snug.



Damaged bolt holes can be repaired with thread repair inserts



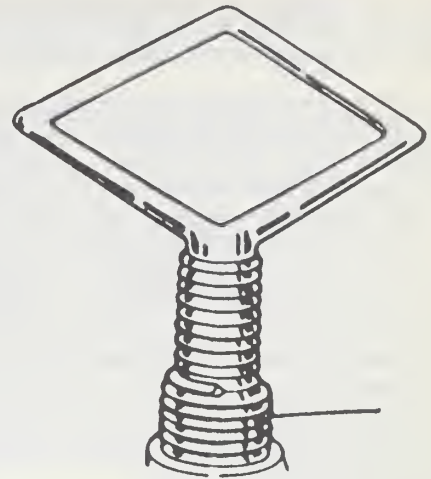
Standard thread repair insert (left) and spark plug thread insert (right)



Drill out the damaged threads with specified drill. Drill completely through the hole or to the bottom of a blind hole



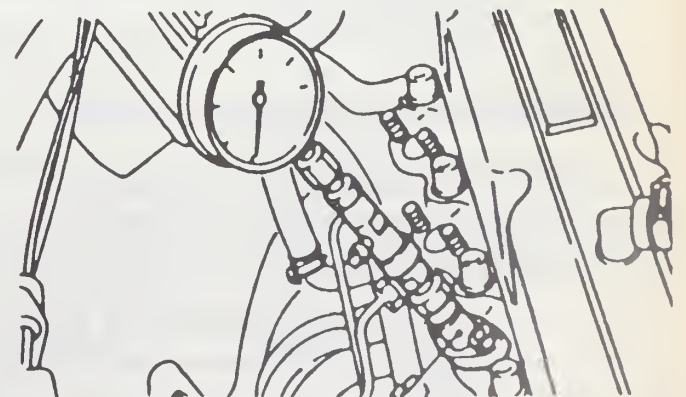
With the tap supplied, tap the hole to receive the thread insert. Keep the tap well oiled and back it out frequently to avoid clogging the threads



Screw the threaded insert onto the installation tool until the tang engages the slot. Screw the insert into the tapped hole until it is $\frac{1}{4}$ – $\frac{1}{2}$ turn below the top surface. After installation break off the tang with a hammer and punch



The screw-in type compression gauge is more accurate



Diesel engines require a special compression gauge adaptor

3 ENGINE AND ENGINE OVERHAUL

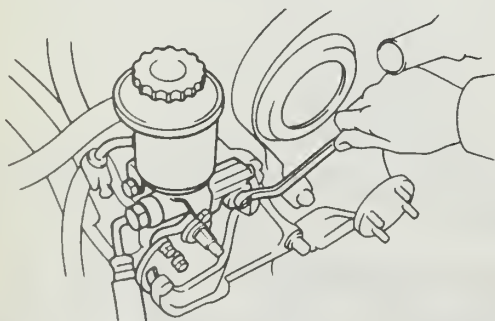
WARNING: Be careful not to crossthread the plug hole. On aluminum cylinder heads use extra care, as the threads in these heads are easily ruined.

6. Ask an assistant to depress the accelerator pedal fully on both carbureted and fuel injected vehicles. Then, while you read the compression gauge, ask the assistant to crank the engine two or three times in short bursts using the ignition switch.

7. Read the compression gauge at the end of each series of cranks, and record the highest of these readings. Repeat this procedure for each of the engine's cylinders. As a general rule, new motors will have compression on the order of 150–170 pounds per square inch (psi). This number will decrease with age and wear. The number of pounds of pressure that your test shows is not as important as the evenness between all the cylinders. Many engines run very well with all cylinders at 105 psi. The lower number simply shows a general deterioration internally. This motor probably burns a little oil and may be a bit harder to start, but, based on these numbers, doesn't warrant an engine tear-down yet.

Compare the highest reading of all the cylinders. Any variation of more than 10% should be considered a sign of potential trouble. For example, on a 4 cylinder engine, if your compression readings for cylinders 1 through 4 were: 135 psi, 125 psi, 90 psi and 125 psi, it would be fair to say that cylinder number three is not working efficiently and is almost certainly the cause of your oil burning, rough idle or poor fuel mileage.

8. If a cylinder is unusually low, pour a tablespoon of clean engine oil into the cylinder through the spark plug hole and repeat the compression test. If the compression comes up after adding the oil, it appears that the cylinder's piston rings or bore are damaged or worn. (The oil sealed some of the leakage.) If the pressure remains low, the valves may not be seating properly (a valve job is needed), or the head gasket may be blown near that cylinder. If compression in any two adjacent cylinders is low, and if the addition of oil doesn't help the compression, there is leakage past the head gasket. Oil and coolant in the combustion chamber can result from this problem. There may also be evidence of water droplets on the engine oil dipstick when a head gasket has blown.



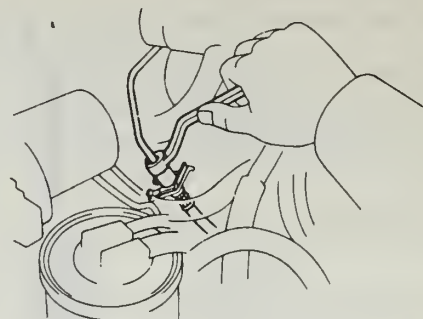
Removing the power steering pump from 3VZ-E

Engine Removal and Installation

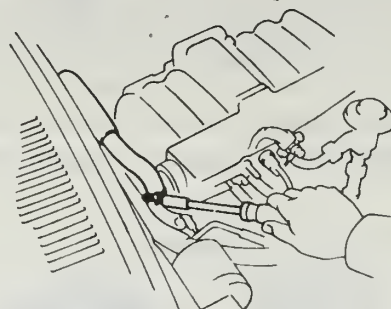
NOTE: All wires and hoses should be labeled at the time of removal. The amount of time saved during reassembly makes the extra effort well worthwhile.

Troubleshooting Engine Mechanical Problems

Problem	Cause	Solution
External oil leaks	• Fuel pump gasket broken or improperly seated	• Replace gasket

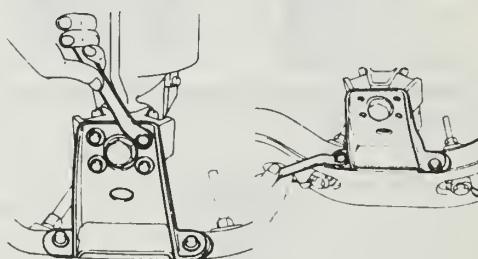


Disconnect the clutch cylinder hose

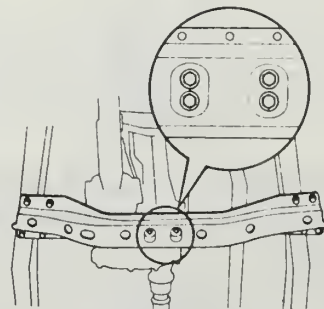


Use caution when disconnecting hoses

2WD



4WD



2WD rear engine mount (above) and 4WD rear mount with No.2 crossmember — 3VZ-E

22R ENGINE

Removal

1. Disconnect the negative battery cable.
2. Remove the engine undercover or splash shield.

Troubleshooting Engine Mechanical Problems (cont.)

Problem	Cause	Solution
External oil leaks	• Cylinder head cover RTV sealant broken or improperly seated • Oil filler cap leaking or missing	• Replace sealant; inspect cylinder head cover sealant flange and cylinder head sealant surface for distortion and cracks • Replace cap
External oil leaks	• Oil filter gasket broken or improperly seated • Oil pan side gasket broken, improperly seated or opening in RTV sealant • Oil pan front oil seal broken or improperly seated • Oil pan rear oil seal broken or improperly seated • Timing case cover oil seal broken or improperly seated • Excess oil pressure because of restricted PCV valve • Oil pan drain plug loose or has stripped threads • Rear oil gallery plug loose • Rear camshaft plug loose or improperly seated • Distributor base gasket damaged	• Replace oil filter • Replace gasket or repair opening in sealant; inspect oil pan gasket flange for distortion • Replace seal; inspect timing case cover and oil pan seal flange for distortion • Replace seal; inspect oil pan rear oil seal flange; inspect rear main bearing cap for cracks, plugged oil return channels, or distortion in seal groove • Replace seal • Replace PCV valve • Repair as necessary and tighten • Use appropriate sealant on gallery plug and tighten • Seat camshaft plug or replace and seal, as necessary • Replace gasket
Excessive oil consumption	• Oil level too high • Oil with wrong viscosity being used • PCV valve stuck closed • Valve stem oil deflectors (or seals) are damaged, missing, or incorrect type • Valve stems or valve guides worn • Poorly fitted or missing valve cover baffles • Piston rings broken or missing • Scuffed piston • Incorrect piston ring gap • Piston rings sticking or excessively loose in grooves • Compression rings installed upside down • Cylinder walls worn, scored, or glazed • Piston ring gaps not properly staggered	• Drain oil to specified level • Replace with specified oil • Replace PCV valve • Replace valve stem oil deflectors • Measure stem-to-guide clearance and repair as necessary • Replace valve cover • Replace broken or missing rings • Replace piston • Measure ring gap, repair as necessary • Measure ring side clearance, repair as necessary • Repair as necessary • Repair as necessary • Repair as necessary

3 ENGINE AND ENGINE OVERHAUL

Troubleshooting Engine Mechanical Problems (cont.)

Problem	Cause	Solution
No oil pressure	- Excessive main or connecting rod bearing clearance - Low oil level - Oil pressure gauge, warning lamp or sending unit inaccurate - Oil pump malfunction - Oil pressure relief valve sticking - Oil passages on pressure side of pump obstructed - Oil pickup screen or tube obstructed - Loose oil inlet tube	- Measure bearing clearance, repair as necessary - Add oil to correct level - Replace oil pressure gauge or warning lamp - Replace oil pump - Remove and inspect oil pressure relief valve assembly - Inspect oil passages for obstruction - Inspect oil pickup for obstruction - Tighten or seal inlet tube
Low oil pressure	- Low oil level - Inaccurate gauge, warning lamp or sending unit - Oil excessively thin because of dilution, poor quality, or improper grade - Excessive oil temperature - Oil pressure relief spring weak or sticking - Oil inlet tube and screen assembly has restriction or air leak - Excessive oil pump clearance - Excessive main, rod, or camshaft bearing clearance	- Add oil to correct level - Replace oil pressure gauge or warning lamp - Drain and refill crankcase with recommended oil - Correct cause of overheating engine - Remove and inspect oil pressure relief valve assembly - Remove and inspect oil inlet tube and screen assembly. (Fill inlet tube with lacquer thinner to locate leaks.) - Measure clearances - Measure bearing clearances, repair as necessary
High oil pressure	- Improper oil viscosity - Oil pressure gauge or sending unit inaccurate - Oil pressure relief valve sticking closed	- Drain and refill crankcase with correct viscosity oil - Replace oil pressure gauge - Remove and inspect oil pressure relief valve assembly
Main bearing noise	- Insufficient oil supply - Main bearing clearance excessive - Bearing insert missing - Crankshaft end play excessive - Improperly tightened main bearing cap bolts - Loose flywheel or drive plate - Loose or damaged vibration damper	- Inspect for low oil level and low oil pressure - Measure main bearing clearance, repair as necessary - Replace missing insert - Measure end play, repair as necessary - Tighten bolts with specified torque - Tighten flywheel or drive plate attaching bolts - Repair as necessary

Troubleshooting Engine Mechanical Problems (cont.)

Problem	Cause	Solution
Connecting rod bearing noise	• Insufficient oil supply • Carbon build-up on piston • Bearing clearance excessive or bearing missing • Crankshaft connecting rod journal out-of-round • Misaligned connecting rod or cap • Connecting rod bolts tightened improperly	• Inspect for low oil level and low oil pressure • Remove carbon from piston crown • Measure clearance, repair as necessary • Measure journal dimensions, repair or replace as necessary • Repair as necessary • Tighten bolts with specified torque
Piston noise	• Piston-to-cylinder wall clearance excessive (scuffed piston) • Cylinder walls excessively tapered or out-of-round • Piston ring broken • Loose or seized piston pin • Connecting rods misaligned • Piston ring side clearance excessively loose or tight • Carbon build-up on piston is excessive	• Measure clearance and examine piston • Measure cylinder wall dimensions, rebore cylinder • Replace all rings on piston • Measure piston-to-pin clearance, repair as necessary • Measure rod alignment, straighten or replace • Measure ring side clearance, repair as necessary • Remove carbon from piston
Valve actuating component noise	• Insufficient oil supply • Push rods worn or bent • Rocker arms or pivots worn • Foreign objects or chips in hydraulic tappets • Excessive tappet leak-down • Tappet face worn • Broken or cocked valve springs • Stem-to-guide clearance excessive • Valve bent • Loose rocker arms • Valve seat runout excessive • Missing valve lock • Push rod rubbing or contacting cylinder head • Excessive engine oil (four-cylinder engine)	• Check for: (a) Low oil level (b) Low oil pressure (c) Plugged push rods (d) Wrong hydraulic tappets (e) Restricted oil gallery (f) Excessive tappet to bore clearance • Replace worn or bent push rods • Replace worn rocker arms or pivots • Clean tappets • Replace valve tappet • Replace tappet; inspect corresponding cam lobe for wear • Properly seat cocked springs; replace broken springs • Measure stem-to-guide clearance, repair as required • Replace valve • Tighten bolts with specified torque • Regrind valve seat/valves • Install valve lock • Remove cylinder head and remove obstruction in head • Correct oil level

3 ENGINE AND ENGINE OVERHAUL

Troubleshooting the Cooling System

Problem	Cause	Solution
High temperature gauge indication—overheating	• Coolant level low • Fan belt loose • Radiator hose(s) collapsed • Radiator airflow blocked • Faulty radiator cap • Ignition timing incorrect • Idle speed low • Air trapped in cooling system • Heavy traffic driving • Incorrect cooling system component(s) installed • Faulty thermostat • Water pump shaft broken or impeller loose • Radiator tubes clogged • Cooling system clogged • Casting flash in cooling passages • Brakes dragging • Excessive engine friction • Antifreeze concentration over 68% • Missing air seals • Faulty gauge or sending unit • Loss of coolant flow caused by leakage or foaming • Viscous fan drive failed	• Replenish coolant • Adjust fan belt tension • Replace hose(s) • Remove restriction (bug screen, fog lamps, etc.) • Replace radiator cap • Adjust ignition timing • Adjust idle speed • Purge air • Operate at fast idle in neutral intermittently to cool engine • Install proper component(s) • Replace thermostat • Replace water pump • Flush radiator • Flush system • Repair or replace as necessary. Flash may be visible by removing cooling system components or removing core plugs. • Repair brakes • Repair engine • Lower antifreeze concentration percentage • Replace air seals • Repair or replace faulty component • Repair or replace leaking component, replace coolant • Replace unit
Low temperature indication—undercooling	• Thermostat stuck open • Faulty gauge or sending unit	• Replace thermostat • Repair or replace faulty component
Coolant loss—boilover	• Overfilled cooling system • Quick shutdown after hard (hot) run • Air in system resulting in occasional "burping" of coolant • Insufficient antifreeze allowing coolant boiling point to be too low • Antifreeze deteriorated because of age or contamination • Leaks due to loose hose clamps, loose nuts, bolts, drain plugs, faulty hoses, or defective radiator • Faulty head gasket • Cracked head, manifold, or block	• Reduce coolant level to proper specification • Allow engine to run at fast idle prior to shutdown • Purge system • Add antifreeze to raise boiling point • Replace coolant • Pressure test system to locate source of leak(s) then repair as necessary • Replace head gasket • Replace as necessary

Troubleshooting the Cooling System (cont.)

Problem	Cause	Solution
Coolant loss—boilover	Faulty radiator cap	Replace cap
Coolant entry into crankcase or cylinder(s)	- Faulty head gasket - Crack in head, manifold or block	- Replace head gasket - Replace as necessary
Coolant recovery system inoperative	- Coolant level low - Leak in system - Pressure cap not tight or seal missing, or leaking - Pressure cap defective - Overflow tube clogged or leaking - Recovery bottle vent restricted	- Replenish coolant to FULL mark - Pressure test to isolate leak and repair as necessary - Repair as necessary - Replace cap - Repair as necessary - Remove restriction
Noise	- Fan contacting shroud - Loose water pump impeller - Glazed fan belt - Loose fan belt - Rough surface on drive pulley - Water pump bearing worn - Belt alignment	- Reposition shroud and inspect engine mounts - Replace pump - Apply silicone or replace belt - Adjust fan belt tension - Replace pulley - Remove belt to isolate. Replace pump. - Check pulley alignment. Repair as necessary.
No coolant flow through heater core	- Restricted return inlet in water pump - Heater hose collapsed or restricted - Restricted heater core - Restricted outlet in thermostat housing - Intake manifold bypass hole in cylinder head restricted - Faulty heater control valve - Intake manifold coolant passage restricted	- Remove restriction - Remove restriction or replace hose - Remove restriction or replace core - Remove flash or restriction - Remove restriction - Replace valve - Remove restriction or replace intake manifold

NOTE: Immediately after shutdown, the engine enters a condition known as heat soak. This is caused by the cooling system being inoperative while engine temperature is still high. If coolant temperature rises above boiling point, expansion and pressure may push some coolant out of the radiator overflow tube. If this does not occur frequently it is considered normal.

GENERAL ENGINE SPECIFICATIONS

Years	Engine	Fuel System Type	Engine Configuration	Bore × Stroke	Comp. (psi)	Oil Press. (psi.) @ 3000 rpm
1989	22R	Carb	L4 OHC®	3.62 × 3.50	142-171	36-71
	22R-E	FI	L4 OHC			
	3VZ-E	FI	V-6 OHC	3.44 × 3.23	142-171	36-75
	3F-E	FI	L6	3.70 × 3.74	114-149	36-71 ①
1990	22R	Carb	L4 OHC	3.62 × 3.50	142-171	36-71
	22R-E	FI				
	3VZ-E	FI	V-6 OHC	3.44 × 3.23	142-171	36-75
	3F-E	FI	L6	3.70 × 3.74	114-149	36-71 ①

3 ENGINE AND ENGINE OVERHAUL

GENERAL ENGINE SPECIFICATIONS

Years	Engine	Fuel System Type	Engine Configuration	Bore × Stroke	Comp. (psi)	Oil Press. (psi.) @ 3000 rpm
1991	22R-E	FI	L4 OHC	3.62 × 3.50	142-171	36-71
	3VZ-E	FI	V-6 OHC	3.44 × 3.23	142-171	36-75
	3F-E	FI	L6	3.70 × 3.74	114-179	36-71 ①

① @ 4000 rpm

② Overhead camshaft

VALVE SPECIFICATIONS

Year	Engine No. Cyl. Liters	Seat Contact Angle	Face Angle (deg.)	Spring Test Pressure (lbs. @ in.)	Spring Free Height (in.)	Stem-to-Guide Clearance (in.)		Stem Diameter (in.)	
						Intake	Exhaust	Intake	Exhaust
1989-91	22R	45°	44.5°	66.1-62.8 @ 1.594	1.909	0.0010-0.0024	0.0012-0.0026	0.3138-0.3144	0.3136-0.3142
	22R-E	45°	44.5°	66.1-62.8 @ 1.594	1.909	0.0010-0.0024	0.0012-0.0026	0.3138-0.3144	0.3136-0.3142
	3VZ-E	45°	44.5°	57-54 @ 1.575	1.81979	0.0010-0.0024	0.0012-0.0026	0.3138-0.3144	0.3136-0.3142
	3F-E	45°	44.5°	71.6-59.5 @ 1.693	2.028	0.0010-0.0024	0.0014-0.0028	0.3138-0.3144	0.3134-0.3140

CAMSHAFT SPECIFICATIONS

(All specifications in inches)

Years	Engine	Journal Diameter					Journal Oil Clearance	Elevation		End Play
		1	2	3	4	5		Int.	Exh.	
1989-91	22R	1.2984-	1.2984-	1.2984-	1.2984-	1.2984-	0.0004-	1.6783-	1.6807-	0.0031-
	22R-E	1.2992	1.2992	1.2992	1.2992	1.2992	0.0020	1.6891	1.6842	0.0071
	3VZ-E	1.3370-	1.3370-	1.3370-	1.3370-	1.3370-	0.0010-	1.8842-	1.8842-	0.0031-
		1.3376	1.3376	1.3376	1.3376	1.3376	0.0026	1.8882	1.8882	0.0075
	3F-E	1.8880-	1.8289-	1.7699-	1.7108-		0.0010-	1.5102-	1.5059-	0.0079-
		1.8888	1.8297	1.7707	1.7116		0.0030	1.5142	1.5098	0.0114

PISTON AND RING SPECIFICATIONS

(All specifications in inches)

Years	Engine No. Cyl. Liters	Ring Gap			Ring Side Clearance			Piston Clearance
		#1 Compr.	#2 Compr.	Oil Control	#1 Compr.	#2 Compr.	Oil Control	
1989-91	22R	0.0098-	0.0236-	0.0079-	0.0012-	0.0012-	0.0012-	0.0006-
	22R-E	0.0185	0.0323	0.0224	0.0028	0.0028	0.0028	0.0014
	3VZ-E	0.0091-	0.0150-	0.0059-	0.0012-	0.0012-	0.0012-	0.0031-
		0.0130	0.0189	0.0157	0.0028	0.0028	0.0028	0.0039
	3F-E	0.0079-	0.0197-	0.0079-	0.0012-	0.0020-	—	0.0011-
		0.0165	0.0283	0.0323	0.0028	0.0035		0.0019

TORQUE SPECIFICATIONS

(All specifications in ft. lbs.)

Years	Engine	Cyl. Head	Conn. Rod	Main Bearing	Crankshaft Pulley	Flywheel	Manifold	
							Intake	Exhaust
1989-91	22R	58	51	76	116	80	14	33
	22R-E	58	51	76	116	80	14	33
	3VZ-E	33 ① 27 ②	18 ③	45 ③	181	65	13	29

TORQUE SPECIFICATIONS

(All specifications in ft. lbs.)

Years	Engine	Cyl. Head	Conn. Rod	Main Bearing	Crankshaft Pulley	Flywheel	Manifold	
							Intake	Exhaust
	3F-E	90	43	19 mm Bolt 99 17 mm Bolt 85	253	64	Int & Exh: 14 mm Bolt: 37 17 mm Bolt: 51 Nut: 41	

① Set to 33 ft. lbs., then turn 90°, then 90° again

② 9th head bolt—torque after all others

③ Set to spec., then turn 90°

CRANKSHAFT AND CONNECTING ROD SPECIFICATIONS

(All specifications in inches)

Years	Engine No. Cyl. Liters	Crankshaft				Connecting Rod		
		Main Bearing Journal Dia.	Main Bearing Oil Clearance	Shaft End Play	Thrust on No.	Journal Dia.	Oil Clearance	Side Clearance
1989-91	22R	2.3616-	0.0010-	0.0008-	3	2.2047-	0.0010-	0.0063-
	22R-E	2.3622	0.0022	0.0087		2.2050	0.0022	0.0102
	3VZ-E	2.5195-	0.0009-	0.0008-	2	①	0.0009-	0.0059-
		2.5197	0.0017	0.0098			0.0021	0.0130
	3F-E	②	0.0006- 0.0022	0.0006- 0.0080	3	2.0861- 2.0866	0.0008- 0.0020	0.0063- 0.0118

① No. 1: 2.2835-2.2838

No. 2: 2.2838-2.2841

No. 3: 2.2843-2.2844

② No. 1: 2.6367-2.6376

No. 2: 2.6957-2.6967

No. 3: 2.8139-2.8148

3. Disconnect the windshield washer hose and then remove the hood. Scribe matchmarks around the hinges for easy installation.

4. Drain the engine oil. Drain the engine coolant from the radiator and the cylinder block.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

5. Drain the automatic transmission fluid on models so equipped.

6. Disconnect the air cleaner hoses and then remove the air cleaner.

7. Remove the fan coupling with the fan.

8. Disconnect the two heater hoses at the engine.

9. Remove the radiator with the shroud attached.

10. Disconnect the accelerator cable at the carburetor.

11. Tag and disconnect the following wires:

a. VSV wire at the EVAP canister

b. VSV wire at the air conditioning compressor

c. Vacuum switch wire

d. HAC wire (ex. Calif.)

e. Cold mixture heater wire

f. Fuel cut solenoid wire

g. Water temperature sender gauge wire

h. EACV wire (Calif.)

i. Starter wire

j. Oil pressure switch wire.

12. Disconnect the following parts:

a. Brake booster hose

b. Main fuel line at the fuel inlet pipe

c. Fuel return line at the fuel return pipe

d. Charcoal canister hose.

e. HAC from the bracket (except Calif.)

f. Vacuum switch, EBCV (Calif.) and VSV with its bracket.

13. Remove the drive belt.

14. Remove the power steering pump from its bracket (if equipped). Move the pump to one side without disconnecting the hoses. Use a piece of stiff wire to support it. Disconnect the ground strap from the bracket.

15. On models with air conditioning, loosen the drive belt and remove the air conditioning compressor. Position it out of the way with the refrigerant lines still attached. Use several pieces of stiff wire to support the compressor.

16. Disconnect the engine ground straps at the rear and right side of the engine.

17. On trucks with a manual transmission, remove the shift lever from inside the truck.

18. On models with automatic transmission, remove the shift lever retainer.

19. Remove the rear driveshaft.

20. On vehicles with automatic transmissions, disconnect the manual shift linkage at the neutral start switch. On wad models with automatic transmission, disconnect the transfer shift linkage at the cross shaft.

21.

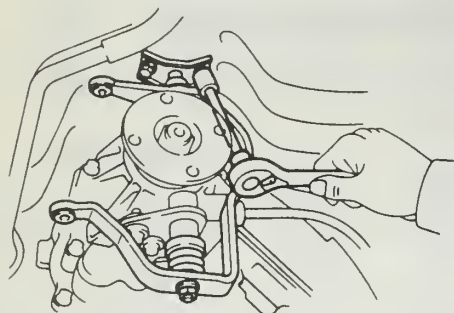
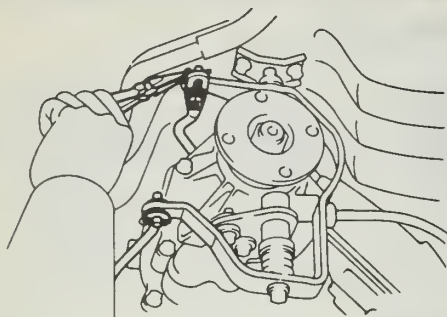
Remove the cross shaft from the body.

22. Disconnect the speedometer cable. Be sure not to lose the felt dust protector and washers.

23. Remove the transfer case undercover (4WD only).

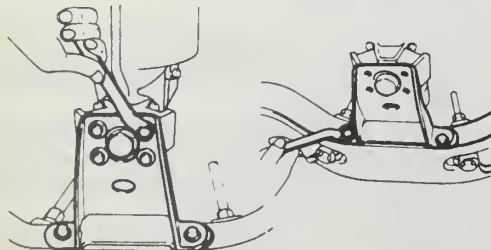
24. Remove the stabilizer bar (4WD only).

3 ENGINE AND ENGINE OVERHAUL



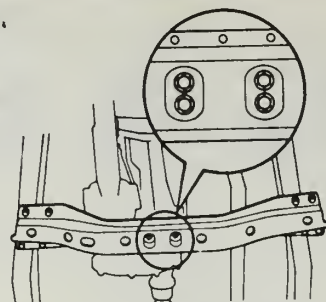
On 4WD with automatic transmission, disconnect the linkage at the cross-shaft, then remove the shaft assembly

25. Remove the front driveshaft (4WD only).
26. Remove the No. 1 frame crossmember.
27. Disconnect the oxygen sensor connector. Disconnect the exhaust pipe at the manifold; remove the clamp from the clutch housing. Remove the exhaust pipe from the catalytic converter.
28. On models with manual transmission, remove the clutch release cylinder and its bracket from the transmission.
29. Remove the No. 1 front floor heat insulator and the brake tube heat insulator (4WD only).
30. On 2WD models, remove the four rear engine mount bolts. Raise the transmission slightly with a floor jack and then remove the four support member mounting bolts.



On 2WD, remove the 4 bolts from the engine rear mount, then remove the support from the crossmember

31. On 4WD models, remove the four rear engine mount bolts, raise the transmission slightly with a floor jack and then remove the four bolts from the side member and remove the No. 2 frame crossmember.
32. Attach an engine hoist chain to the lifting brackets on the engine. Remove the engine mount nuts and bolts and slowly lift the engine/transmission out of the truck.
33. Remove the starter. If automatic transmission, remove the oil cooler lines from the transmission. Remove the two stiffener brackets and the exhaust pipe bracket from the engine.
34. Remove the transmission.



On 4WD, remove the 4 bolts from the engine rear mount and remove the crossmember from the frame rails

35. If manual transmission, remove the clutch cover (pressure plate) and clutch disc.
36. Mount the engine on an engine stand, making sure the retaining bolts are tight. If an engine stand is not available, support the engine in an upright position with blocks. Never leave an engine hanging from a lift or hoist.

Installation

1. Install the clutch and pressure plate onto the engine. Tighten the bolts correctly.
2. Install the transmission onto the engine.
3. Slowly lower the engine assembly into the engine compartment.
4. For 4WD, use a floor jack to raise the transmission onto the crossmember. Always use a piece of wood between the jack and the transmission pan. 5. Align the holes in the engine mount and the frame, install the bolts and then remove the engine hoist chain.
6. On 2WD models, raise the transmission slightly and align the rear engine mount with the support member. Tighten the bolts to 9 ft. lbs. (13 Nm). Lower the transmission until it rests on the extension housing and then tighten the bracket mounting bolts to 19 ft. lbs. (25 Nm).
7. On 4WD models, raise the transmission slightly and tighten the No. 2 frame crossmember-to-side frame bolts to 70 ft. lbs. (95 Nm). Lower the transmission and tighten the four rear engine mount bolts to 9 ft. lbs. (13 Nm).
8. On 4WD models, install the brake tube and front floor heat insulators.
9. Install the clutch release cylinder and its bracket to the manual transmission. Tighten the bracket bolts to 29 ft. lbs. (39 Nm) and the cylinder bolts to 9 ft. lbs. (13 Nm).
10. Reconnect the exhaust pipe to the catalytic converter, and to the exhaust manifold. Install the clamps. Install the connector to the oxygen sensor.
11. Install the No. 1 frame crossmember.
12. On 4WD models, install the front driveshaft, stabilizer bar and the transfer case undercover.
13. Connect the speedometer cable.
14. On 4WD models with automatic transmission, install the cross-shaft to the body. Connect the transfer shift linkage.
15. Connect the manual shift linkage to the neutral start switch (automatic transmission only).
16. Install the rear driveshaft.
17. Install the shift lever (manual transmission) or the shift lever retainer (automatic).
18. Connect the engine ground straps.
19. Install the air conditioning compressor.
20. Install the power steering pump and connect the ground strap to the bracket.
21. Connect all parts removed in Step 12 of the removal procedure.
22. Connect all wires removed in Step 11 of the removal procedure.

23. Connect the accelerator cable to the carburetor — don't forget the tension spring.
24. Install the fan pulley, belt guide, fluid coupling and alternator drive belt.
25. Install the air conditioning compressor belt and adjust it correctly.
26. Install the power steering pump and belt; adjust the belt correctly. Tighten the pump pulley lock nut to 32 ft. lbs. (43 Nm).
27. Install the radiator and shroud. Install the radiator hoses.
28. Connect the two heater hoses and install the air cleaner. Connect the air cleaner hoses.
29. Refill the engine with oil and the radiator with coolant.
30. Install the engine undercover.
31. Install the battery.
32. Install the hood.
33. Double check all installation items, paying particular attention to loose hoses or hanging wires, untightened nuts, poor routing of hoses and wires (too tight or rubbing) and tools left in the engine area.
34. With the coil wire disconnected from the distributor, crank the engine with the ignition key for 5–10 seconds. This should pre-oil at least the lower part of the engine.
35. Reconnect the coil wire. Start the engine, allowing it to warm up. Check carefully for leaks.
36. Check and adjust the engine specifications as necessary.
37. Road test the vehicle. Recheck and top fluid levels as needed.

22R-E ENGINES

Removal

1. Disconnect the negative battery cable.
2. Remove the engine undercover.
3. Disconnect the windshield washer hose and then remove the hood. Scribe matchmarks around the hinges for easy installation.
4. Drain the engine oil. Drain the engine coolant from the radiator and the cylinder block.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

5. Drain the automatic transmission fluid on models so equipped.
6. Remove the air cleaner case and the intake air hose.
7. Remove the radiator and shroud.
8. Loosen the power steering pulley lock nut and remove the power steering belt.
9. If equipped with air conditioning, remove the compressor belt.
10. remove the alternator drive belt, fluid coupling for the fan and the fan pulley.
11. Disconnect the following wires and connectors:
 - a. Ground strap from the left fender apron.
 - b. Alternator connector and wire.
 - c. Igniter connector.
 - d. Alternator wires.
 - e. Coil wire from distributor.
 - f. Ground strap at rear of engine.
 - g. ECU connectors.
 - h. Starter relay connector (manual transmission only)
 - i. The check connector.
 - j. Air conditioning compressor connector
12. Disconnect these hoses: air hoses from the fuel filter and air pipe, brake booster hose, charcoal canister hose and cruise control vacuum hose if so equipped.
13. Disconnect the accelerator cable, the throttle cable for the automatic transmission (if so equipped) and the cruise control cable if so equipped.

14. Remove the power steering pump from its bracket (if equipped).
15. Disconnect the ground strap from the bracket.
16. On models with air conditioning, remove the air conditioning compressor. Position it out of the way with the refrigerant lines still attached.
17. Disconnect the engine ground straps at the rear and right side of the engine.
18. On trucks with a manual transmission, remove the shift lever from inside the truck.
19. Remove the rear driveshaft.
20. On models with automatic transmission, disconnect the manual shift linkage at the neutral start switch.
21. On 4WD models with automatic transmission, disconnect the transfer shift linkage at the cross shaft.
22. Remove the cross shaft assembly from the body.
23. Disconnect the speedometer cable. Be sure not to lose the felt dust protector and washers.
24. Remove the transfer case undercover (4WD only).
25. Remove the stabilizer bar (4WD only).
26. Remove the front driveshaft (4WD only).
27. Remove the No. 1 frame crossmember.
28. Disconnect the oxygen sensor connector. Disconnect the exhaust pipe at the manifold; remove the clamp from the clutch housing. Remove the exhaust pipe from the catalytic converter.
28. On models with manual transmission, remove the clutch release cylinder and its bracket from the transmission.
29. Remove the No. 1 front floor heat insulator and the brake tube heat insulator (4WD only).
30. On 2WD models, remove the four rear engine mount bolts. Raise the transmission slightly with a floor jack and then remove the four support member mounting bolts.
31. On 4WD models, remove the four rear engine mount bolts, raise the transmission slightly with a floor jack and then remove the four bolts from the side member and remove the No. 2 frame crossmember.
32. Attach an engine hoist chain to the lifting brackets on the engine. Remove the engine mount nuts and bolts and slowly lift the engine/transmission out of the truck.
33. Remove the starter. If automatic transmission, remove the oil cooler lines from the transmission. Remove the two stiffener brackets and the exhaust pipe bracket from the engine.
34. Remove the transmission.
35. If manual transmission, remove the clutch cover (pressure plate) and clutch disc.
36. Mount the engine on an engine stand, making sure the retaining bolts are tight. If an engine stand is not available, support the engine in an upright position with blocks. Never leave an engine hanging from a lift or hoist.

Installation

1. Slowly lower the engine assembly into the engine compartment.
2. Raise the transmission onto the crossmember with a floor jack.
3. Align the holes in the engine mounts and the frame, install the bolts and then remove the engine hoist chain.
4. On 2WD models, raise the transmission slightly and align the rear engine mount with the support member and tighten the bolts to 9 ft. lbs. (13 Nm). Lower the transmission until it rests on the extension housing and then tighten the bracket mounting bolts to 19 ft. lbs. (25 Nm).
5. On 4WD models, Raise the transmission slightly and tighten the No. 2 frame crossmember-to-side frame bolts to 70 ft. lbs. (95 Nm). Lower the transmission and tighten the four rear engine mount bolts to 9 ft. lbs. (13 Nm).
6. On 4WD models, install the brake tube and front floor heat insulators.
7. Install the clutch release cylinder and its bracket to the

3 ENGINE AND ENGINE OVERHAUL

manual transmission. Tighten the bracket bolts to 29 ft. lbs. (39 Nm) and the cylinder bolts to 9 ft. lbs. (13 Nm).

8. Reconnect the exhaust pipe.
9. Install the No. 1 frame crossmember.
10. On 4WD models, install the front driveshaft, stabilizer bar and the transfer case undercover.
11. Connect the speedometer cable.
12. Connect the transfer shift linkage on 4WD models with automatic transmission.
13. Connect the manual shift linkage to the neutral start switch (automatic transmission only).
14. Install the rear driveshaft.
15. Install the shift lever (manual transmission only).
16. Connect the engine ground straps.
17. Install the air conditioning compressor.
18. Install the power steering pump and connect the ground strap.
19. Connect the cables disconnected in Step 13 of the removal procedure.
20. Connect the hoses to the charcoal canister, the brake booster, the cruise control if so equipped and the air hoses to the fuel filter and air pipe.
21. Connect the wires and connectors removed in Step 11 of the removal procedure.
22. Install the fan pulley, belt guide, fluid coupling and alternator belt.
23. Install the air conditioning compressor drive belt.
24. Install the power steering pump belt and adjust it correctly. Tighten the pump pulley lock nut to 32 ft. lbs. (43 Nm).
25. Install the radiator and shroud.
26. Install the air cleaner case and the intake duct.
27. Install the proper amounts of oil and coolant.
28. Install the undercover or splash shield below the engine.
29. Install the battery.
30. Install the hood.
31. Double check all installation items, paying particular attention to loose hoses or hanging wires, untightened nuts, poor routing of hoses and wires (too tight or rubbing) and tools left in the engine area.
32. With the coil wire disconnected from the distributor, crank the engine with the ignition key for 5-10 seconds. This should pre-oil at least the lower part of the engine.
33. Reconnect the coil wire. Start the engine, allowing it to warm up. Check carefully for leaks.
34. Check and adjust the engine specifications as necessary.
35. Road test the vehicle. Recheck and top fluid levels as needed.

3VZ-E ENGINES

Removal

1. Disconnect the battery cables and remove the battery.
2. Remove the engine undercover.
3. Disconnect the windshield washer hose and then remove the hood. Scribe matchmarks around the hinges for easy installation.
4. Drain the engine oil. Drain the engine coolant from the radiator and the cylinder block.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

5. Drain the automatic transmission fluid on models so equipped.
6. Disconnect the air cleaner hose and then remove the air cleaner.
7. Remove the radiator.
8. Remove all drive belts and then remove the fluid coupling and fan pulley.

9. Tag and disconnect the following wires and connectors:
 - a. Left side and rear ground straps
 - b. Alternator connector and wire
 - c. Igniter connector
 - d. Oil pressure switch connector
 - e. ECU connectors
 - f. VSV connectors
 - g. Starter relay connector (manual transmission only)
 - h. Solenoid resistor connector
 - i. Check connector
 - j. Air conditioning compressor connector
 - k. Air conditioning compressor connector, if so equipped.
10. Tag and disconnect the following hoses:
 - a. Air hoses at the gas filter and air pipe
 - b. Brake booster hose
 - c. Cruise control vacuum hose (if equipped)
 - d. Charcoal canister hose at the canister
 - e. VSV vacuum hoses.
11. Disconnect the accelerator cable, throttle control cable (auto. trans.) and cruise control cable if equipped.
12. Unbolt the power steering pump and position it out of the way with the hydraulic lines still connected.
13. Remove the air conditioning compressor if equipped. Position is out of the way with the lines still attached.
14. Disconnect the clutch release cylinder hose (manual transmission only).
15. Disconnect the two heater hoses from the engine.
16. Disconnect and plug the fuel inlet and outlet lines.
17. Remove the shift levers (manual transmission only).
18. Remove the rear driveshaft.
19. Disconnect the manual shift linkage (automatic transmission only).
20. Disconnect the speedometer cable — don't lose the felt dust protector and washers.
21. Remove the transfer case undercover.
22. Remove the stabilizer bar.
23. Remove the front drive shaft.
24. Remove the No.1 frame crossmember.
25. Remove the front exhaust pipe.
26. Remove the No. 1 front floor heat insulator and the brake tube heat insulator.
27. Remove the four rear engine mount bolts, raise the transmission slightly with a floor jack and then remove the four bolts from the side member and remove the No. 2 frame crossmember.
28. Attach an engine hoist chain to the lifting brackets on the engine. Remove the engine mount nuts and bolts and slowly lift the engine/transmission out of the truck.
29. Remove the starter. If automatic transmission, remove the oil cooler lines from the transmission. Remove the two stiffener brackets and the exhaust pipe bracket from the engine.
30. Remove the transmission.
31. If manual transmission, remove the clutch cover (pressure plate) and clutch disc.
32. Mount the engine on an engine stand, making sure the retaining bolts are tight. If an engine stand is not available, support the engine in an upright position with blocks. Never leave an engine hanging from a lift or hoist.

Installation

1. After connecting the transmission to the engine and installing the starter, slowly lower the engine assembly into the engine compartment.
2. Raise the transmission onto the crossmember with a floor jack. Be certain to use a broad piece of wood between the transmission pan and the floor jack.
3. Align the holes in the engine mounts and the frame, install the bolts and then remove the engine hoist chain.
4. For 2WD vehicles, install the rear engine mount and bracket. Install the bolts holding the bracket to the support and

tighten them to 9 ft. lbs. (13 Nm). Lower the transmission, resting it on the extension housing. Install the bracket to the mount; tighten the bolts to 19 ft. lbs. (25 Nm)

5. On 4WD vehicles, raise the transmission slightly and tighten the No. 2 frame crossmember-to-side frame bolts to 70 ft. lbs. (95 Nm). Lower the transmission and tighten the four rear engine mount bolts to 9 ft. lbs. (13 Nm).

6. Install the brake tube and front floor heat insulators.

7. Reconnect the exhaust pipe.

8. Install the No. 1 frame crossmember.

9. Install the front driveshaft.

10. Install the stabilizer bar and the transfer case undercover. Connect the speedometer cable.

11. Connect the manual shift linkage (automatic transmission only).

12. Install the rear driveshaft.

13. Install the shift levers (manual transmission only).

14. Install the fuel inlet and outlet lines.

15. Connect the heater hoses.

16. Connect the clutch release cylinder hose.

17. Install the air conditioning compressor.

18. Install the power steering pump and connect the ground strap.

19. Connect the throttle, cruise control and accelerator cables.

20. Connect the hoses removed in Step 10 of the removal procedure.

21. Connect the wires removed in Step 9 of the removal procedure.

22. Install the fan pulley, belt guide, fluid coupling and drive belt.

23. Install the air conditioning belt.

24. Install the power steering pump and connect the ground strap. Tighten the pump pulley lock nut to 32 ft. lbs. (43 Nm).

25. Install the radiator and shroud.

26. Install the air cleaner. Refill the engine with oil and the radiator with coolant.

27. Install the engine undercover.

28. Install and adjust the hood.

28. Install the battery.

29. Double check all installation items, paying particular attention to loose hoses or hanging wires, untightened nuts, poor routing of hoses and wires (too tight or rubbing) and tools left in the engine area.

30. With the coil wire disconnected from the distributor, crank the engine with the ignition key for 5-10 seconds. This should pre-oil at least the lower part of the engine.

31. Reconnect the coil wire. Start the engine, allowing it to warm up. Check carefully for leaks.

32. Check and adjust the engine specifications as necessary.

33. Road test the vehicle. Recheck and top fluid levels as needed.

3F-E ENGINES

Removal

1. Drain the engine coolant. Drain the engine oil.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

2. Scribe matchmarks around the hood hinges and then remove the hood.

3. Remove the battery and its tray.

4. Disconnect the accelerator and throttle cables.

5. Disconnect the air flow meter connector and clamp. Disconnect the ISC hose, the air pump hose, distributor hose, PCV hose, the 3 hoses from the rear of the intake chamber, and the 2

vacuum hoses from the canister. Disconnect the air intake hose clamp.

6. Remove the air intake hose, air flow meter and air cleaner cap. Remove the air cleaner element. Remove the three bolts and the air cleaner case.

7. Remove the coolant reservoir tank; remove the radiator.

8. Tag and disconnect the following wires and connectors:

a. Oil pressure connector

b. High tension cord at the coil

c. Neutral start switch and transfer connectors near the starter

d. Front differential lock connector

e. Starter wire and connector

f. Starter ground strap

g. Oxygen sensor connectors

h. Alternator wire and connector

i. Cooling fan connector

j. Check connector.

k. Connector on right fender apron.

9. Disconnect the following hoses:

a. Heater hoses

b. Fuel hoses

c. Transfer hose

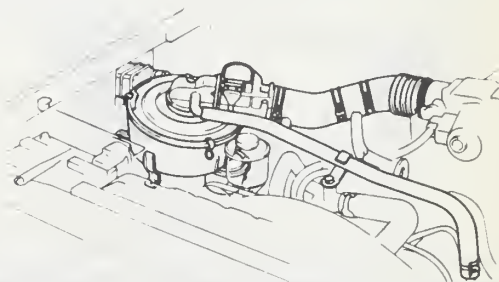
d. Brake booster hose

e. Air control valve hoses

f. Distributor hose

g. Emission control hoses.

10. Remove the glove box, disconnect the four fuel injection connectors and then carefully pull the EFI wiring harness through the firewall.



Use care in removing the air cleaner assembly



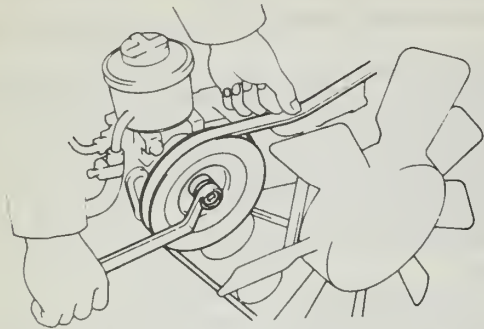
The fuel injection harness must be brought through the firewall

11. Loosen the power steering pump pulley on its shaft. Loosen the idler pulley nut and bolt; remove the drive belt. Remove the pulley mounting nut, drive pulley and woodruff key. Unbolt the power steering pump and remove it from the bracket.

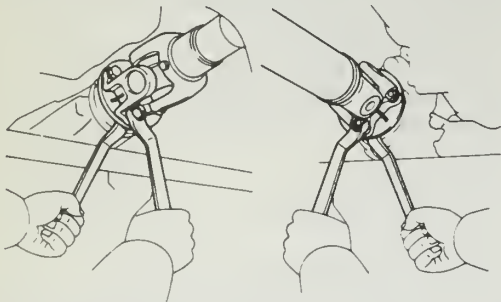
12. At the air conditioning compressor, disconnect the wiring lead. Loosen the idler pulley and adjuster; remove the belt. Remove the 4 compressor mounting bolts. Position the compressor out of the way with the hoses still attached. Use stiff wire to support the unit; do not allow the compressor to hang by the hoses.

13. Raise the vehicle, making sure it is well supported. Remove the transfer case undercover.

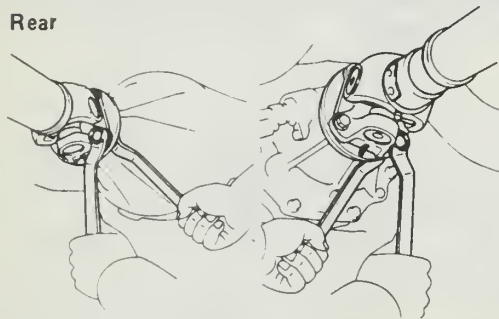
3 ENGINE AND ENGINE OVERHAUL



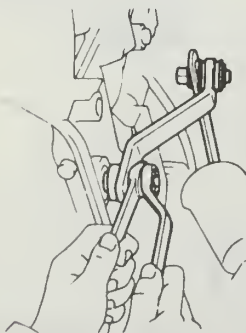
Holding the belt aids in removing the pump pulley
Front



Rear



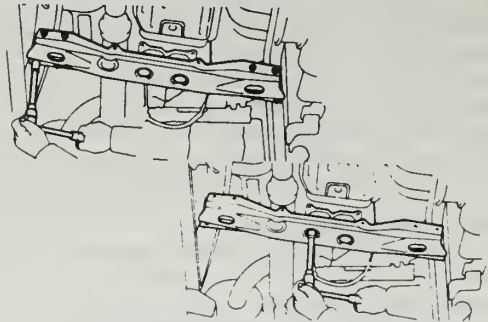
Always use a second wrench to counterhold driveshaft bolts



Disconnecting the transmission control rod

14. Remove the front and rear drive shafts.
15. Disconnect the speedometer cable.
16. Disconnect the transmission control rod.
17. Disconnect the exhaust pipe at the manifold.
18. Position a floor jack under the transmission with a broad piece of wood to protect the pan. Remove the eight bolts and two nuts that attach the frame crossmember and then remove the crossmember.
19. Attach an engine hoist chain to the lifting brackets on the engine. Remove the engine mount nuts and bolts and slowly lift the engine/transmission out of the truck.

20. Remove the oil cooler lines from the transmission.
21. Remove the transmission from the engine.
22. Mount the engine on an engine stand, making sure the retaining bolts are tight. If an engine stand is not available, support the engine in an upright position with blocks. Never leave an engine hanging from a lift or hoist.



Removing the frame crossmember

Installation

1. Install the transmission and oil cooler lines to the engine. Slowly lower the engine assembly into the engine compartment.
2. Raise the transmission onto the crossmember with a floor jack.
3. Align the holes in the engine mounts and the frame, install the bolts and then remove the engine hoist chain.
4. Raise the transmission slightly and tighten the frame crossmember-to-chassis bolts to 29 ft. lbs. (39 Nm). Tighten the two nuts to 43 ft. lbs. (59 Nm).
5. Install the exhaust pipe with a new gasket and tighten the nuts (new!) to 46 ft. lbs. (62 Nm).
6. Connect the speedometer cable.
7. Install the front and rear drive shafts. Tighten the nuts to 65 ft. lbs. (88 Nm).
8. Install the transfer case undercover.
9. Install the air conditioning compressor.
10. Install the power steering pump and tighten the pulley nut to 35 ft. lbs. (47 Nm).
11. Carefully feed the fuel injection harness through the firewall. Connect the 4 connectors to the ECU.
12. Install the glove box.
13. Connect the hoses removed in Step 9 of the removal procedure.
14. Connect the wires and connectors removed in Step 8 of the removal procedure.
15. Install the radiator and the coolant reservoir tank.
16. Install air cleaner case and the element. Install the air intake hose, air flow meter and air cleaner cap. Connect the hoses removed in Step 5 of the removal procedure.
17. Connect the accelerator and throttle cables. Be sure to adjust them.
18. Refill the engine with oil and the radiator with coolant.
26. Install the battery tray and battery.
27. Double check all installation items, paying particular attention to loose hoses or hanging wires, untightened nuts, poor routing of hoses and wires (too tight or rubbing) and tools left in the engine area.
28. With the coil wire disconnected from the distributor, crank the engine with the ignition key for 5-10 seconds. This should pre-oil at least the lower part of the engine.
29. Reconnect the coil wire. Start the engine, allowing it to warm up. Check carefully for leaks.
30. Check and adjust the engine specifications as necessary.
31. Install the hood.
33. Road test the vehicle. Recheck and top fluid levels as needed.

Cylinder Head Cover (Valve Cover)

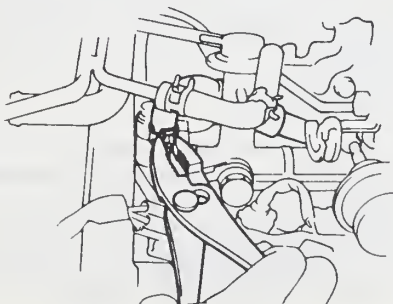
REMOVAL AND INSTALLATION

22R, 22R-E and 3F-E

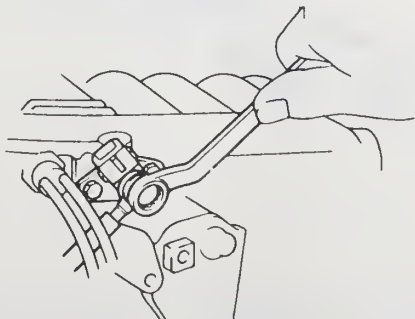
1. On 22R and 22R-E, remove the ground strap. On 3F-E, remove the air cleaner hose.
2. Disconnect the PCV hose(s) from the cam cover.
3. Remove the nuts and washers. Lift the cover off the cylinder head. Cover the oil return hole in the head to prevent dirt or objects from falling in. Remove the gasket.
4. To install, replace the cover gasket if it shows any signs of damage, breaks or cracking. Tighten the nuts evenly: 4-cylinder engines to 48 inch lbs; 6-cylinder to 78 inch lbs. Do not overtighten these nuts.
5. Reconnect the PCV hose and install the air cleaner hose or ground strap.

3VZ-E

1. Disconnect the throttle position sensor.
2. Disconnect the canister vacuum hose from the throttle body.
3. Disconnect the vacuum and fuel hoses from the pressure regulator.
4. Disconnect PCV hose from the hose union.
5. Disconnect the No. 4 water bypass hose from the union at the intake manifold.

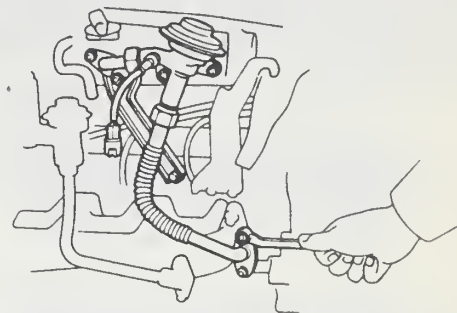


Removing the No.4 (above) and No.5 water bypass hoses

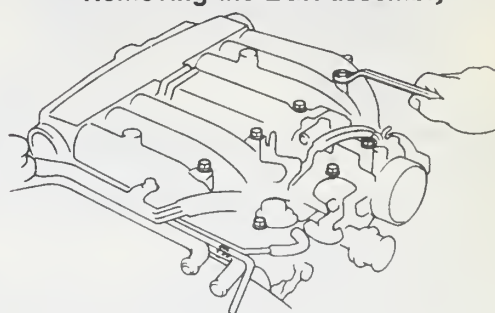


Carefully remove the cold start injector

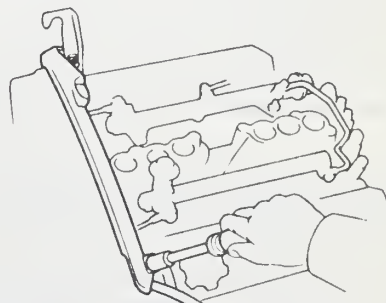
6. Remove the No.5 water bypass hose from the water bypass pipe.
7. Disconnect the cold start injector connector.
8. Disconnect the vacuum hose from the fuel filter.



Removing the EGR assembly



Disconnecting the intake chamber



Two bolts hold the engine wiring harness in place

9. Remove the union bolt and the two gaskets and the cold start injector tube.
10. On California vehicles, disconnect the EGR temperature sensor connector.
11. Disconnect the EGR vacuum hoses from the air pipe and EGR vacuum modulator.
12. Remove the nut, bolt and intake manifold stay (support).
13. Disconnect the 2 water bypass hoses from the EGR valve.
14. Remove the 5 nuts and remove the EGR valve with the pipes and 2 gaskets.
15. Disconnect the No.1 air hose from the reed valve.
16. Remove the 6 bolts and 2 nuts holding the intake manifold; remove the gasket.
17. Disconnect the following wires:
 - a. Knock sensor connector
 - b. No. 2 water temperature switch connector
 - c. Start injection timer
 - d. Water temperature sensor connector.
 - e. Water temperature sender gauge connector
 - f. Right side engine ground strap
 - g. Injector connectors
18. Remove the two bolts holding the engine wire harness and remove the harness.

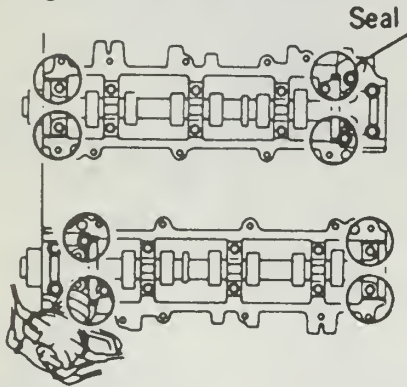
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19. Remove the bolts holding the valve cover(s); remove the cover(s) and gaskets.

To install:

20. Examine the gasket closely for any sign of cracking or deformation. Replace the gasket if necessary.

21. Place the gasket on the cover. Apply sealant at the 4 corners of each head as shown in the illustration. Do not apply sealant to the entire gasket.



Apply sealant in each of these areas before installing the valve cover

22. Place the valve cover and gaskets in place on the head and install the small retaining bolts. Tighten them evenly only to 5-6 ft. lbs. Do not overtighten.

23. Install the engine wire harness with its two bolts. Connect all the connectors disconnected in Step 17.

24. Position a new gasket on the intake manifold. Install the manifold, tightening the six bolts and two nuts to 13 ft. lbs. (18 Nm).

25. Connect the No.1 air hose to the reed valve.

26. Install two new gaskets to the intake manifold and right side exhaust manifold. Install the EGR valve and pipes.

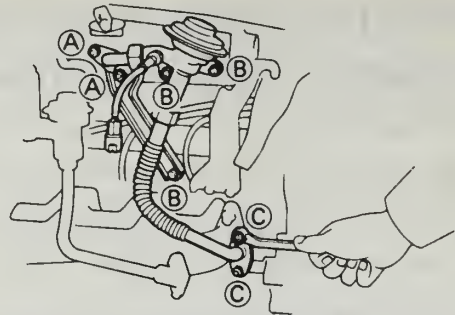
27. Install the two water bypass hoses to the EGR if so equipped.

28. Install the intake manifold support; tighten the groups of bolts to the proper torque—refer to the diagram for designations. Group A bolts should be tightened to 9 ft. lbs. (12 Nm), group B to 13 ft. lbs. (18 Nm) and group C bolts to 22 ft. lbs. (29 Nm).

29. Connect the EGR hoses to the air pipe and the EGR vacuum modulator. For California vehicles, connect the EGR temperature sensor connector.

30. Use a new gasket and connect the cold start injector tube. Tighten the union bolt to 13 ft. lbs. (18 Nm).

31. Connect the vacuum hose to the fuel filter, then connect the cold start injector connector.



Tighten each group of bolts correctly

32. Install the 2 water bypass hoses, one to the bypass pipe and the other to the hose union.

33. Connect the PCV hose to the hose union.

34. Connect the vacuum and fuel hoses to the pressure regulator.

35. Connect the canister vacuum hose to the throttle body.

36. Connect the throttle position sensor wire.

Rocker Arms and Shafts

REMOVAL AND INSTALLATION

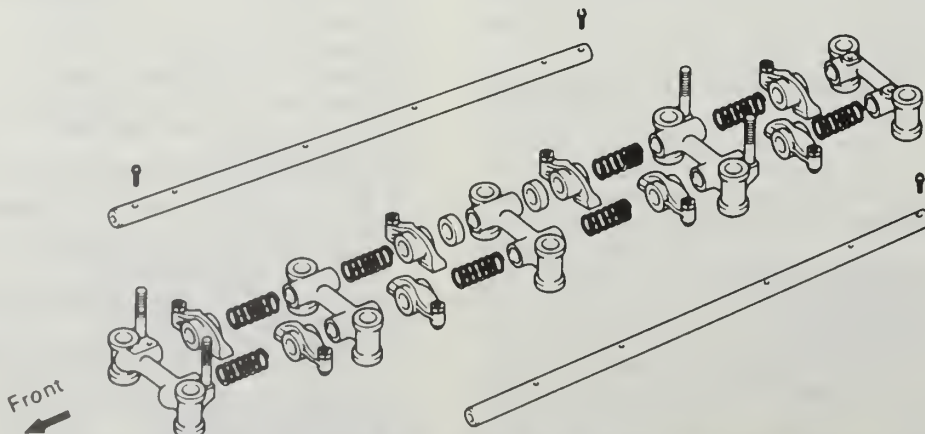
NOTE: The 3VZ-E engine operates the valves through the direct action of the camshaft; it does not have rocker arms or shafts.

22R and 22R-E Engines

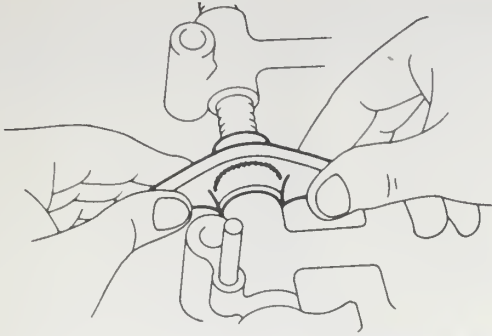
WARNING: The rocker shaft assembly is held by the head bolts. Removing the rocker shaft assembly loosens the head. Removal of the head to replace the head gasket is **REQUIRED** any time the head bolts are loosened. Refer to Cylinder Head Removal and Installation later in this Section. **NEVER** attempt to re-compress the same gasket after the head bolts are loosened.

1. Remove the valve cover. The head bolts must be loosened in the correct order to avoid head damage. Once loosened and removed, gently remove the rocker shaft assembly. It may be necessary to use gentle prying force at the ends of the assembly to lift it off the head. Do not damage the head during removal.

2. Remove the three retaining screws and slide the rocker supports, springs and rocker arms off of the shafts. Keep all parts in order; the shafts must be reassembled in the correct order.

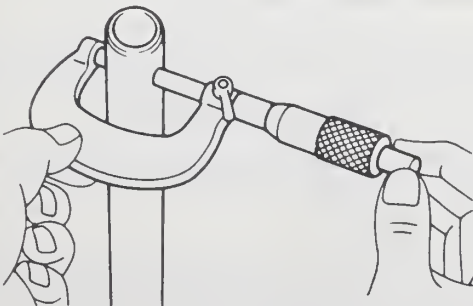
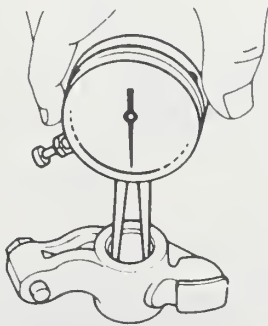


Exploded view of rocker arms and shafts — 22R and 22R-E



Wiggle the rocker on the shaft to check for excess free play

3. Inspect the rocker arm-to-shaft wear by wiggling the arm laterally on the shaft. Little or no movement should be felt.
4. If movement is found in the arm-to-shaft wiggle test, measure the oil clearance as follows:
 - a. Measure the outside diameter of the rocker shaft with a micrometer.
 - b. Measure the inside diameter of the rocker arms with a dial indicator.
 - c. The difference between the rocker arm inner diameter and the shaft outer diameter is the oil clearance. Correct clearance is 0.0004–0.0020 in. (0.01–0.05mm). Maximum allowable clearance is 0.0031 in. (0.08mm)
5. Inspect the face of each rocker; the surface should be smooth, shiny and evenly shaped. Any sign of metal wear or scratching requires replacement of the rocker and a detailed inspection of the camshaft.



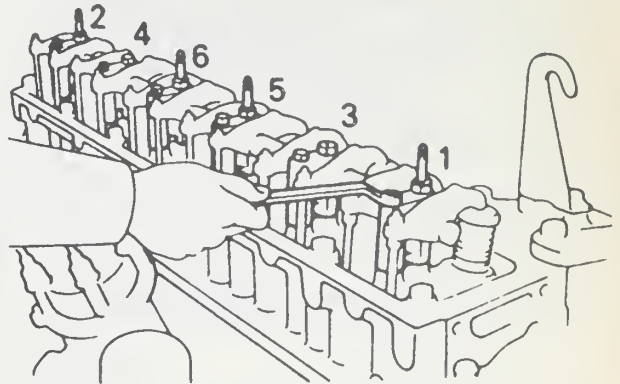
Measuring the rocker inner diameter and the shaft outer diameter to determine oil clearance

NOTE: The condition of the rocker surfaces and matching camshaft lobes are your report card for oil and filter changes. If you have been less than prompt about performing routine oil changes, chances are good that the rockers and/or cam lobes are scored or damaged from poor oiling. The amount of sludge in the head is also a good indicator of poor oil change frequency.

6. Reassemble the rocker shafts, arms and towers in their exact original order.
7. Remove the head, replace the gasket and reinstall the head and rocker assembly. Tighten the bolts correctly.
8. Adjust the valve clearance. Install the valve cover.

3F-E

1. Remove the valve cover.
2. The rocker assembly is held by 8 bolts and 4 nuts. These must be loosened evenly in several passes. Do not loosen any one fitting all at once. Loosen the nuts and bolts in the correct order.



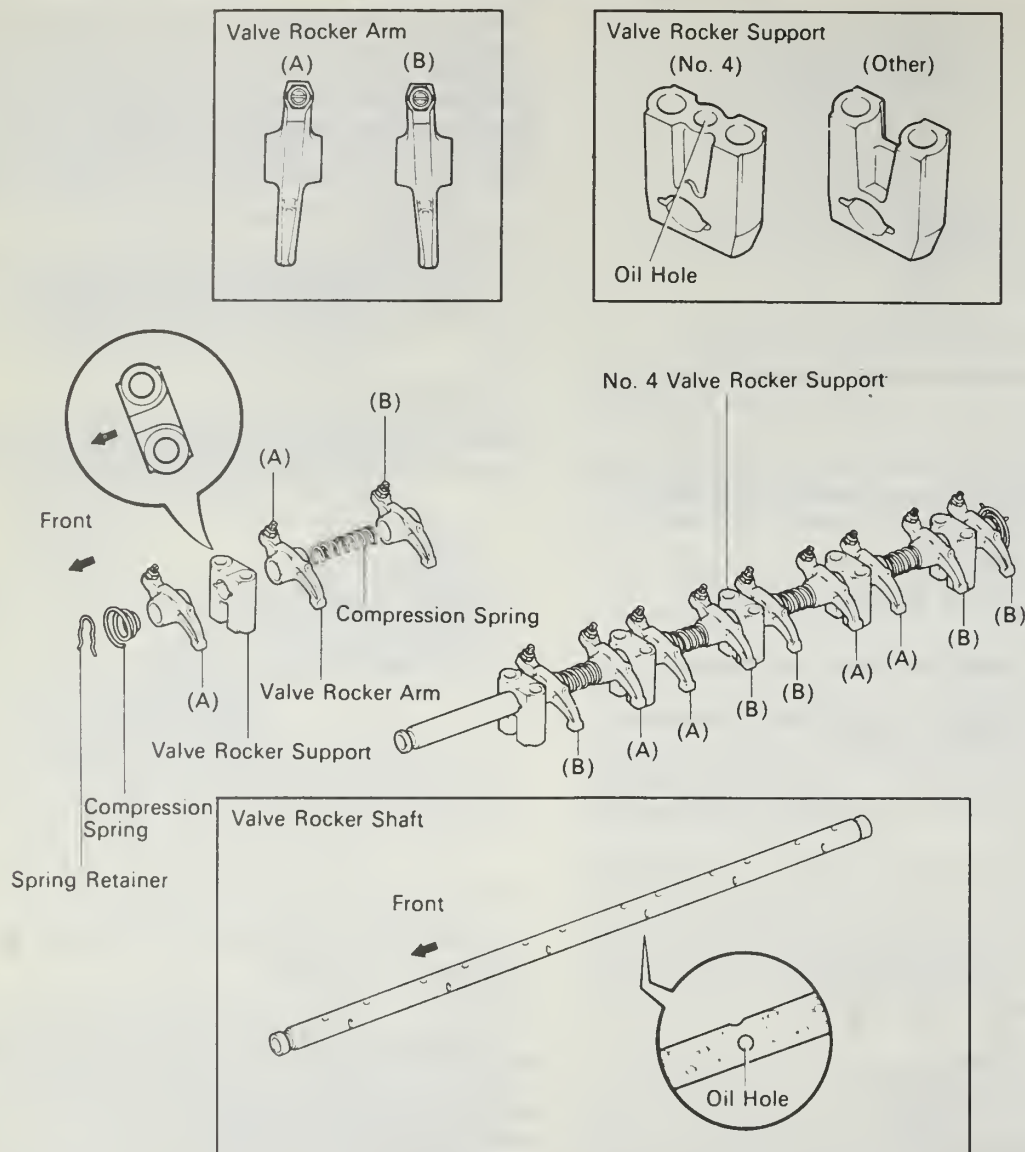
Loosen the 3F-E rocker assembly bolts in several passes in this order

3. Inspect the rocker arm-to-shaft wear by wiggling the arm laterally on the shaft. Little or no movement should be felt.
4. If movement is found in the arm-to-shaft wiggle test, disassemble the assembly and keep every piece in exact order. Measure the oil clearance as follows:
 - a. Measure the outside diameter of the rocker shaft with a micrometer.
 - b. Measure the inside diameter of the rocker arms with a dial indicator.
 - c. The difference between the rocker arm inner diameter and the shaft outer diameter is the oil clearance. Correct clearance is 0.0004–0.0020 in. (0.01–0.05mm). Maximum allowable clearance is 0.0031 in. (0.08mm)
5. Inspect the face of each rocker; the surface should be smooth, shiny and evenly shaped. Any sign of metal wear or scratching requires replacement of the rocker and a detailed inspection of the camshaft.

NOTE: The condition of the rocker surfaces and matching camshaft lobes are your report card for oil and filter changes. If you have been less than prompt about performing routine oil changes, chances are good that the rockers and/or cam lobes are scored or damaged from poor oiling. The amount of sludge in the head is also a good indicator of poor oil change frequency.

6. Reassemble the rocker shafts, arms and towers in their exact original order.
7. Place the rocker shaft assembly on the cylinder head. Align the adjusting screws with the heads of the pushrods.

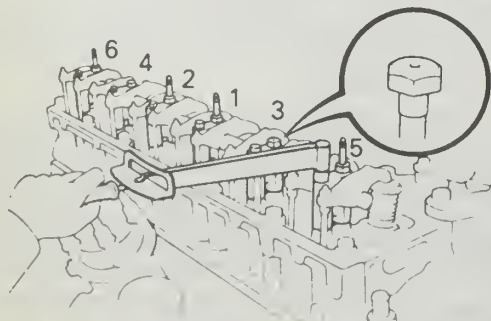
3 ENGINE AND ENGINE OVERHAUL



Exploded view of 3F-E rocker assembly

8. Install the retaining bolts. Tighten them in the correct order and in several passes to the correct torque. The 12mm bolt heads should be tightened to 17 ft. lbs. (24 Nm). The 14mm bolt head and the nut should be tightened to 25 ft. lbs. (33 Nm).

9. Adjust the valve clearance. Reinstall the valve cover.



Tighten the 3F-E rocker assembly bolts in several passes in this order

Thermostat

REMOVAL AND INSTALLATION

1. Drain the cooling system.

CAUTION

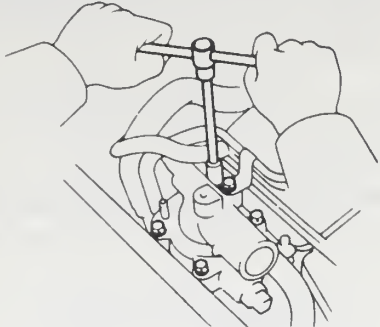
Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

2. Disconnect the radiator hose(s) from the thermostat housing. On 3F-E, disconnect the 2 vacuum hoses from the BVS, the cold start injector time switch wire and the water temperature switch connector.

3. Remove the bolts and remove the water outlet. On 3F-E, remove the clamp bolt for the ISC water bypass pipe. Make certain to remove the gasket with the water outlet. Some of it will probably stick to the housing and require scraping.

4. Remove the thermostat. The factory recommended thermostat temperature is 190° for all engines. If testing the thermostat, allowable operating range is 186–194 °F or 86–90 °C.

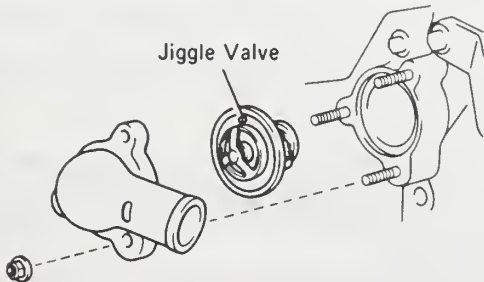
5. When installing a new thermostat always use a new gasket. Be sure that the thermostat is positioned with the spring down or into the housing. On 3VZ-E, the jiggle valve (looks like a small rivet in the edge of the thermostat) must be at the top or 12 o'clock position.



Removing the 3F-E water outlet



3VZ-E water outlet



The jiggle valve allows air to escape; it must be at the top during installation

6. Install the water outlet. Install the bolts finger tight until the outlet is positioned exactly. Tighten the bolts to 10–14 ft. lbs. Overtightening will break the ear off the housing and spoil your afternoon—don't do it.

7. Install the hoses and wire connectors removed for access. Make certain the coolant hoses are not kinked or twisted after installation. Do not overtighten the hose clamps.

8. Fill the cooling system with coolant. Start the engine and check carefully for leaks.

Intake Manifold REMOVAL AND INSTALLATION

22R Engines

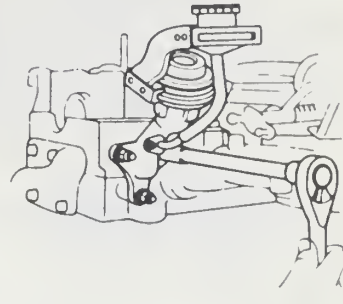
1. Disconnect the battery.
2. Drain the cooling system.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

3. Remove the air cleaner assembly, complete with hoses, from the carburetor.

4. Label and disconnect the vacuum lines from the EGR valve and carburetor. Disconnect the EGR pipe from the manifold; remove the EGR valve with the pipe attached.



Removing the EGR valve — 22R

5. Remove the fuel lines, electrical leads, accelerator linkage, and water hose from the carburetor.

6. Remove the water by-pass hose from the manifold.

7. Unbolt and remove the intake manifold, complete with carburetor and EGR valve.

8. Cover the cylinder head ports with clean shop cloths to keep anything from falling into the cylinder head or block.

To install:

9. When installing the manifold, always replace the gasket with a new one. Torque the mounting nuts and bolts to 14 ft. lbs. (19 Nm). Tighten the bolts in several stages working from the inside bolts outward.

10. Connect the by-pass line and all other lines and hoses.

11. Install the air cleaner and refill the cooling system.

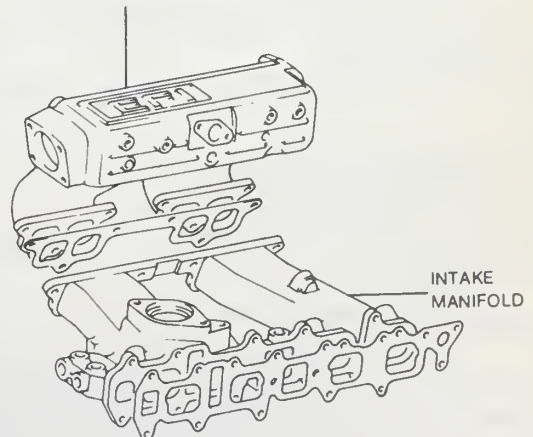
22R-E Engines

1. Disconnect the negative battery cable.
2. Drain the cooling system.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

AIR INTAKE CHAMBER



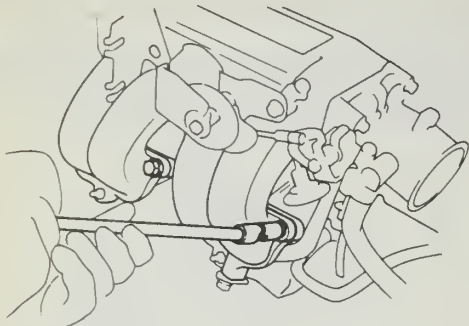
Intake manifold and air chamber — 22R-E engine

3. Disconnect the air intake hose from both the air cleaner assembly on one end and the air intake chamber on the other.

4. Tag and disconnect all vacuum lines attached to the intake chamber and manifold.

5. Tag and disconnect the wires to the cold start injector,

3 ENGINE AND ENGINE OVERHAUL



Removing the air chamber and throttle body from the intake manifold on 22R-E engines

throttle position sensor, and the water hoses from the throttle body.

6. Remove the EGR valve from the intake chamber.
7. Tag and disconnect the actuator cable, accelerator cable and automatic transmission throttle cable (if equipped) from the cable bracket on the intake chamber.
8. Unbolt the air intake chamber from the intake manifold and remove the chamber with the throttle body attached.
9. Disconnect the fuel hose from the fuel delivery pipe.
10. Disconnect the air valve hose from the intake manifold.
11. Make sure all hoses, lines and wires are tagged for later installation and disconnected from the intake manifold. Unbolt the air intake chamber from the intake manifold.
12. Unbolt the manifold from the cylinder head, removing the delivery pipe and injection nozzles with the manifold.

To install:

13. Position a new gasket on the cylinder head.
14. Install the intake manifold with the fuel delivery pipe and injection nozzles.
15. Install the bolts and nuts. Tighten them evenly to 14 ft. lbs (19 Nm).
16. Install the EGR valve. Clean the bolt threads, removing any carbon or oil deposits. For the bolt closest to the front of the engine, apply sealant to the 2 or 3 threads closest to the end of the bolt. Install the bolts and nuts.
17. Install the air intake chamber with the throttle body. Use a new gasket. Tighten the bolts to 14 ft. lbs. (19 Nm).
18. Install the EGR wires and hoses.
19. Connect the air valve hose.
20. Connect the fuel hose to the fuel delivery pipe.
21. Install the actuator cable, accelerator cable, and throttle control cable (auto. trans.).
22. Connect the wires to the cold start injector, fuel injectors, throttle position sensor. Connect the water hoses to the throttle body.
23. Connect the vacuum lines.
24. Install the air intake tubing.
25. Refill the cooling system with coolant.
26. Connect the negative battery cable.

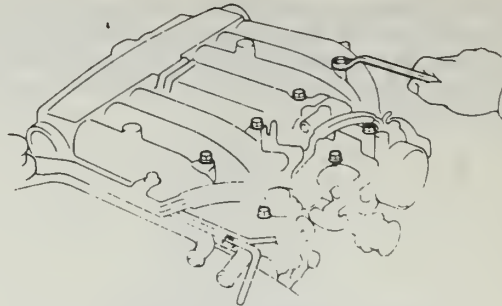
3VZ-E Engines

1. Disconnect the negative battery cable.
2. Drain the cooling system.

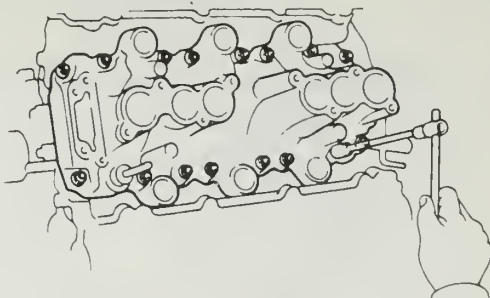
CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

3. Disconnect the air intake hose from both the air cleaner assembly on one end and the air intake chamber on the other.
4. Tag and disconnect all vacuum lines attached to the intake chamber and manifold.
5. Disconnect the throttle position sensor connector at the air chamber. Disconnect the PCV hose at the union.



Removing 3VZ-E air intake chamber



Intake manifold retaining bolts — 3VZ-E

6. Disconnect the No.4 water by-pass hose at the manifold. Remove the No. 5 by-pass hose at the water by-pass pipe.
7. Disconnect the cold start injector and the vacuum hose at the fuel filter.
8. Remove the union bolt and two gaskets and then remove the cold start injector tube.
9. Disconnect the EGR gas temperature sensor (Calif.) and the EGR vacuum hoses from the air pipe and the vacuum modulator.
10. Remove the EGR valve.
11. Disconnect the No. 1 air hose at the reed valve.
12. Remove the air intake chamber and then remove the engine wire harness (held with 2 bolts).
13. Remove the four union bolts and then remove the Nos. 2 and 3 fuel pipes.
14. Remove the No. 4 timing belt cover. Remove the No. 2 idler pulley and the No. 3 timing belt cover.
15. Remove the fuel delivery pipes with their injectors.
16. Remove the water by-pass outlet. Progressively loosen the retaining bolts and remove the intake manifold.

To install:

17. Install the intake manifold with new gaskets and tighten the mounting bolts to 29 ft. lbs. (39 Nm).
18. Install the water by-pass outlet and tighten the two bolts to 13 ft. lbs. (18 Nm).
19. Install the fuel delivery pipes and injectors.
20. Install the No. 2 idler pulley. Install the Nos. 3 and 4 timing belt covers and tighten the bolts to 74 inch lbs. (8.3 Nm).
21. Install the fuel pipes and tighten the union bolts to 22 ft. lbs. (29 Nm).
22. Install the engine wire harness.
23. Install the air intake chamber and tighten the nuts and bolts to 13 ft. lbs. (18 Nm).
24. Install the EGR valve and connect all hoses and lines.
25. Install the air cleaner duct.
26. Refill the engine with coolant.
27. Connect the negative battery cable.

3F-E

1. Drain the engine coolant.

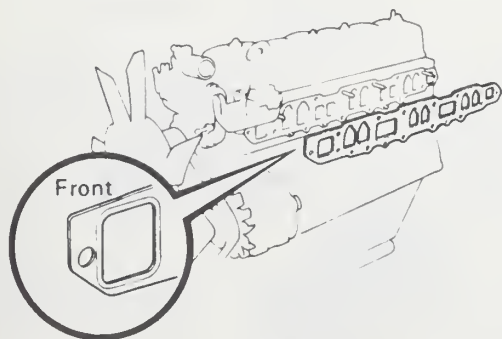
CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by the ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old.

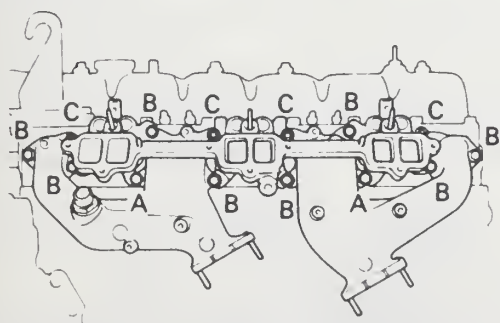
2. Disconnect the negative battery cable.
3. Disconnect the accelerator and throttle control cables.
4. Remove the air intake hose, air flow meter and air cleaner.
5. Disconnect or reposition all the wires and hoses running near or through the intake and exhaust manifolds. Remove the heat shields from the exhaust manifolds.
6. Disconnect the exhaust pipes from the exhaust manifold.
7. Progressively loosen the retaining bolts holding the intake and exhaust manifolds.
8. Remove the intake and exhaust manifolds. They are individual pieces. Remove the combination gasket.

To install:

9. Place a new gasket so that the FRONT mark is towards the front side, facing outward.
10. Install the intake and exhaust manifolds with the ten bolts, four plate washers and nuts. Tighten the nuts and bolts correctly. Use the illustration for correct placement: A-17mm bolts, 51 ft. lbs. (69 Nm); B-14mm bolts, 37 ft. lbs. (50 Nm) and C-nuts, 41 ft. lbs. (56 Nm).



The combination gasket must be correctly placed on 3F-E engines



3F-E manifold bolts must be tightened correctly

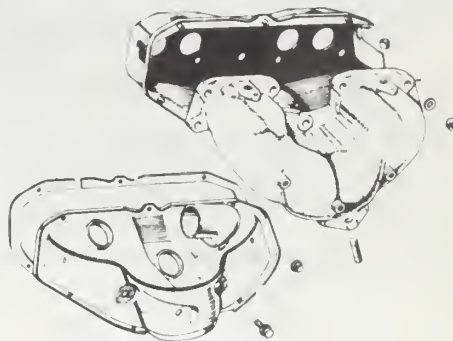
11. Install new gaskets and secure the exhaust pipes to the manifold.
12. Install the heat shields and manifold support.
13. Connect the wires and hoses removed in Step 5.
14. Install the air cleaner, air flow meter and air intake duct.
15. Connect the accelerator and throttle control cables.
16. Fill the system with coolant.
17. Connect the negative battery cable.

Exhaust Manifold

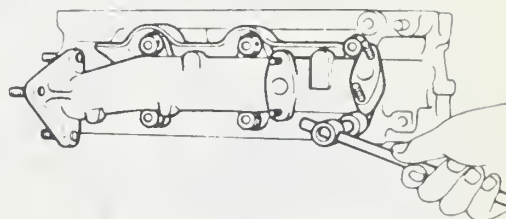
REMOVAL AND INSTALLATION

22R, 22R-E, and 3VZ-E Engines

1. Remove the three exhaust pipe flange bolts and disconnect the exhaust pipe from the manifold.
2. Tag and disconnect the spark plug leads. Position the spark plug wires out of the way. It is best to tie them so they don't get in your way.



22R exhaust manifold



3VZ-E left (above) and right manifolds

3. Remove the air cleaner tube from the heat stove on carbureted engines, and remove the outer part of the heat stove.
4. Use a 14mm wrench to remove the manifold retaining nuts.
5. Remove the manifold(s), complete with air injection tubes and the inner portion of the heat stove.
6. For 22R, separate the inner portion of the heat stove from the manifold.
7. Always use a new gasket. Install any disassembled parts onto the manifold and place it in position.
8. Install the nuts and bolts, tightening them to 30 ft. lbs. (40 Nm).
9. Install the air cleaner and spark plug leads. Connect the air intake tube(s).
10. Connect the exhaust pipe to the manifold, tightening the bolts to 30 ft. lbs. (40 Nm).

3 ENGINE AND ENGINE OVERHAUL

Air Conditioning Compressor

REMOVAL AND INSTALLATION

PLEASE RE-READ THE AIR CONDITIONING SECTION IN SECTION ONE SO THAT THE SYSTEM MAY BE DISCHARGED PROPERLY. ALWAYS WEAR EYE PROTECTION AND GLOVES WHEN DISCHARGING THE SYSTEM. OBSERVE NO SMOKING/NO OPEN FLAME RULES.

1. Turn the engine on and let it idle for ten minutes with the air conditioning switched ON.
2. Turn the engine off and disconnect the negative battery cable.
3. For 3VZ-E, remove the power steering pump. On 3F-E, remove the engine undercover.
4. Disconnect the compressor clutch wire at the connector.
5. Safely discharge the refrigerant from the system.
6. Disconnect the two refrigerant lines at the compressor. Cap the open fitting immediately to keep moisture out of the system.
5. Remove the fan shroud and then remove the air conditioning drive belt.

6. Remove the mounting bolts and lift out the compressor. The compressor is heavy; support it before removing the retaining bolts.

7. Install the compressor and tighten the mounting bolts to 18 ft. lbs. (25 Nm).

8. Install the drive belt and adjust the tension.

9. Connect the two refrigerant lines to the compressor. Tighten the suction line to 24 ft. lbs. (32 Nm) and the discharge line to 16 ft. lbs. (22 Nm).

10. Connect the compressor clutch wire.

11. Install the power steering pump or engine undercover if they were removed.

12. Connect the negative battery cable.

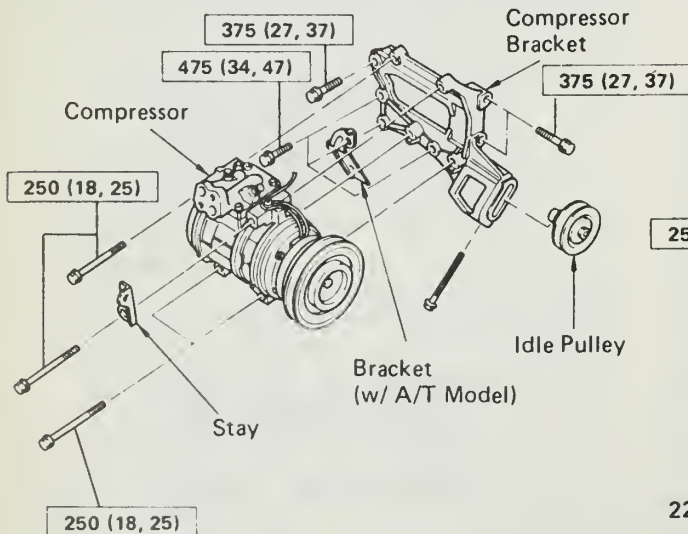
11. Evacuate and charge the system.

Radiator

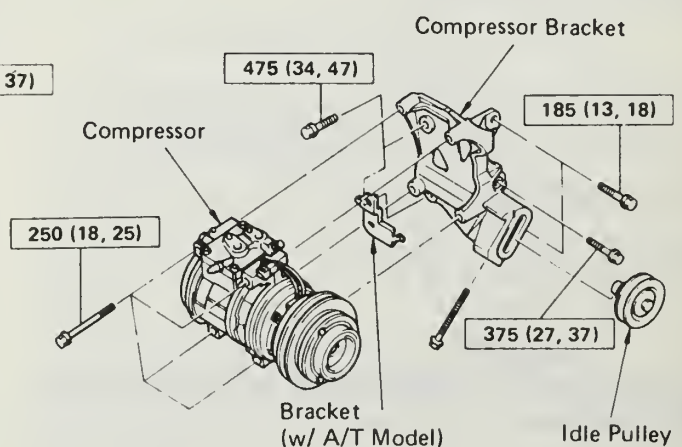
REMOVAL AND INSTALLATION

1. Drain the cooling system.

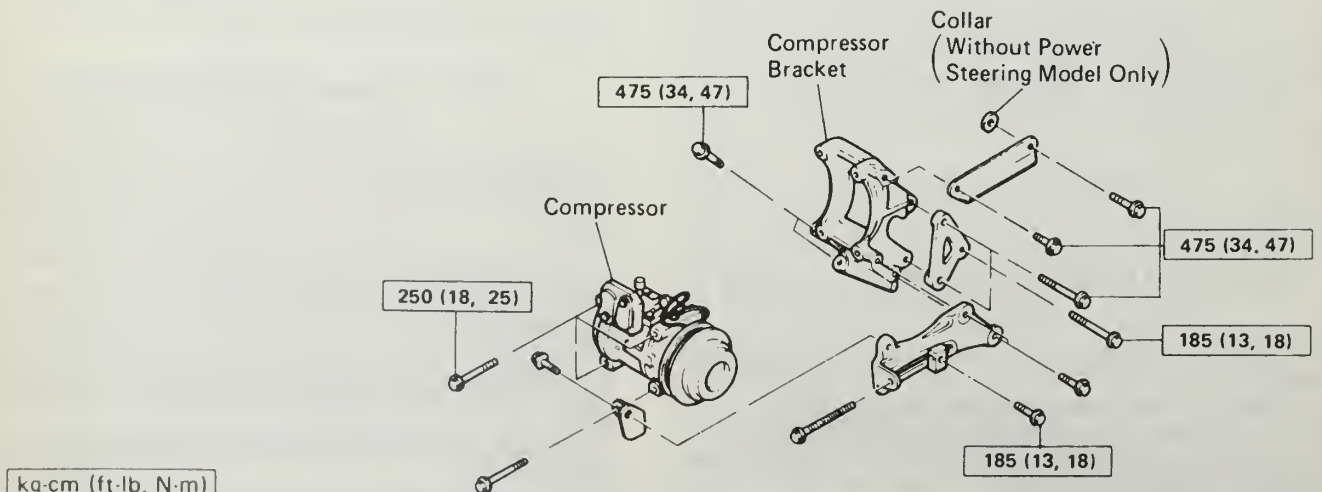
3VZ-E E/G



22R-E E/G

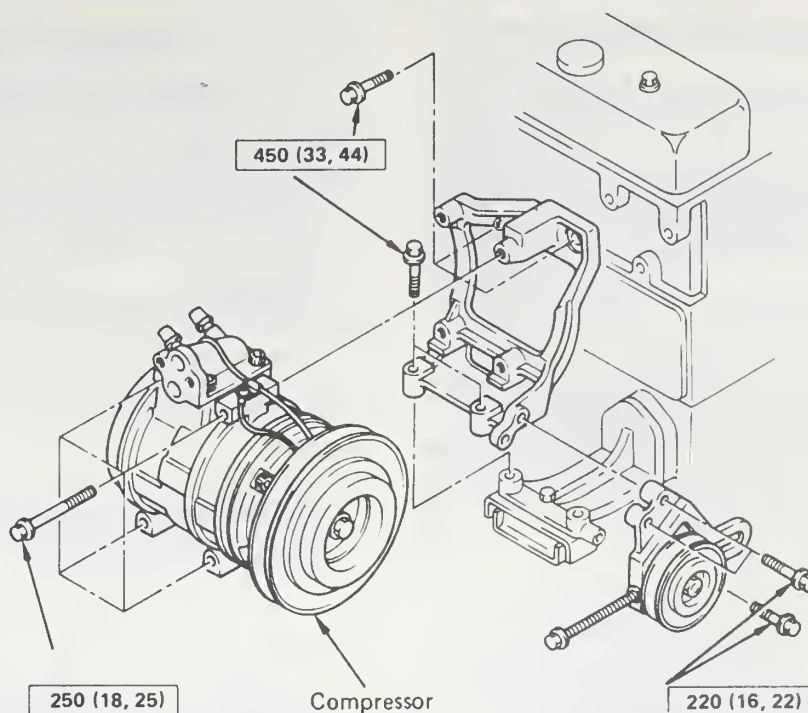


22R E/G w/ Air Pump



kg-cm (ft-lb, N-m)

Compressors and brackets for 3VZ-E and 22R-E engines



kg-cm (ft-lb, N·m)

3F-E air conditioning compressor

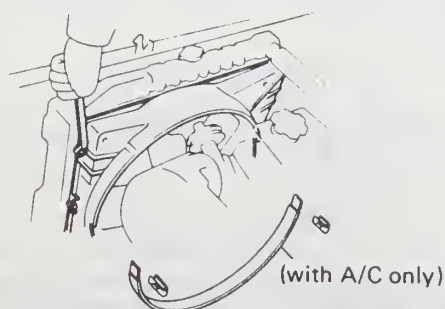
CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

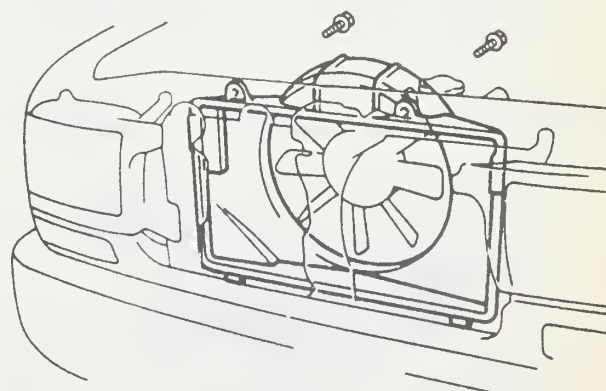
2. Remove the engine undercover. On Land Cruiser, remove the grille.
3. On Land Cruiser, remove the battery and battery case.
4. Disconnect the reservoir hose and remove the reservoir tank.
5. Disconnect the radiator hoses; on Land Cruiser, disconnect just the inlet hose.
6. On Land Cruiser, remove the power steering and air conditioning drive belts.
7. Remove the fan shrouds. For Land Cruiser, remove the fan and the fluid coupling.
8. Disconnect the Land Cruiser outlet hose.
9. Disconnect the oil cooler lines (automatic transmission). Plug the lines immediately to prevent oil loss.
10. Remove the nuts and bolts holding the radiator. Carefully remove the radiator.

CAUTION

Use care not to damage the radiator fins or the cooling fan.



Radiator shrouds — 22R and 22R-E



Land Cruiser radiator and fan shroud

To install:

11. Install the radiator and tighten the mounting bolts. Make certain all the rubber mounts and bushings are present and correctly placed.
10. Install oil cooler lines if they were removed. connect the Land Cruiser outlet hose to the radiator.
12. Install the Land Cruiser fan and fluid coupling. Install the fan shrouds on all models.
13. Install the Land Cruiser drive belts—alternator, power steering and compressor. Adjust the belts to the correct tension.
14. Connect the radiator hoses.
15. Install the reservoir tank and connect the hoses.
16. On Land Cruiser, install the grille, battery case and battery.
17. Fill the radiator to the specified level and check for leaks.
18. On vehicles with automatic transmissions, check the level of the transmission fluid and adjust as needed. Some fluid will have been lost from the bottom of the radiator after removal.

3 ENGINE AND ENGINE OVERHAUL

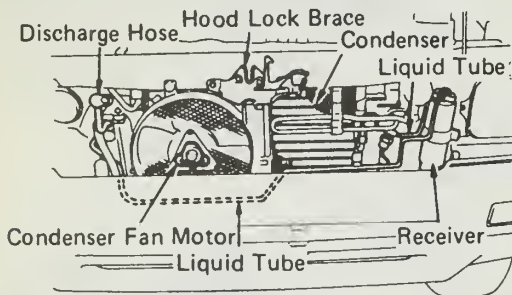
Air Conditioning Condenser

REMOVAL AND INSTALLATION

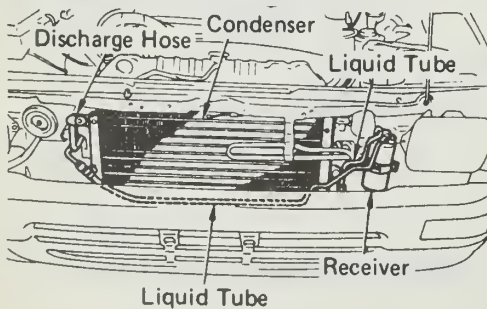
CAUTION

PLEASE RE-READ THE AIR CONDITIONING SECTION IN SECTION ONE SO THAT THE SYSTEM MAY BE DISCHARGED PROPERLY. ALWAYS WEAR EYE PROTECTION AND GLOVES WHEN DISCHARGING THE SYSTEM. OBSERVE NO SMOKING/NO OPEN FLAME RULES.

1. Properly discharge the refrigerant system.
2. Disconnect the negative battery cable.
3. On Land Cruiser, remove the hood lock brace and the center support brace. On trucks, remove the grille and hood lock brace. On 4Runner, remove the marker lights and grille.
4. Disconnect the discharge hose from the condenser inlet fitting. Disconnect the liquid tubes from the receiver/drier. Cap the lines immediately to prevent entry of dirt.
5. On 4Runner, remove the hood lock brace and remove the electric fan and motor from the condenser.



4Runner condenser and related components



Truck condenser

6. Remove the retaining bolts and remove the condenser.
- To install:**
6. Place the unit in position and install the retaining bolts. Make certain the rubber bushings and supports are present and correctly installed.
 7. For 4Runner, install the electric fan and the hood lock brace.
 8. If the condenser has been replaced with a new one, add 40–50 cc (1.4–1.7 fl. oz.) of compressor oil into the condenser. Do not add oil if the original condenser is being reinstalled. Connect the discharge hose and tighten it to 14 ft. lbs. (18 Nm). Connect the lines to the receiver and tighten them only to 48 inch lbs. (4 ft. lbs or 5 Nm). Do not overtighten.
 9. Install the hood lock brace, center support, grille and lighting as necessary.
 10. Connect the negative battery cable.
 11. Evacuate the system, then recharge.

Engine Cooling Fan

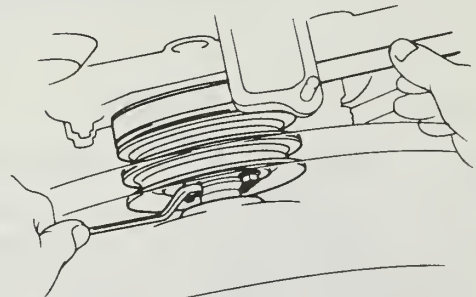
REMOVAL AND INSTALLATION

22R and 22R-E

1. Remove the belt.
2. Loosen the bolts holding the water pump pulley (not the pump).
3. Remove the nuts. Remove the fan clutch (fluid coupling), fan and pulley.
4. Install the pulley, clutch and fan; loosely fit the nuts in place.
5. Install the drive belts onto the water pump pulley. Tighten the nuts.
6. Install the belts to the other pulleys and adjust the belts.

3VZ-E

1. Press on the belt to hold the pulley under tension. Loosen the set bolts holding the fan pulley.
2. Loosen the pivot bolt and adjusting bolt for the alternator and remove the alternator belt.



Loosening the pulley set nuts

3. Remove the four nuts. Remove the fluid coupling (fan clutch), fan pulley and belt guide.
4. Install in reverse order. Adjust the alternator belt correctly.

3F-E

NOTE: The Land Cruiser uses an electric cooling fan at the radiator. The fan circuit is controlled by a relay located behind the right kick panel in the passenger compartment. Check the relay first if the fan is not operating.

The electric fan will only operate when needed. If the engine is sufficiently cool, the fan will stay off.

1. With the ignition OFF, disconnect the connector at the fan.
2. Remove the fan shroud.
3. Remove the air intake silencer and support.
4. Remove the 3 bolts and remove the cooling fan assembly.
5. Reassemble in reverse order.

Water Pump

REMOVAL AND INSTALLATION

22R and 22R-E

1. Drain the cooling system.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

2. Unfasten the fan shroud securing bolts and remove the fan shroud, if so equipped.
3. Loosen the alternator adjusting bolt and remove the drive belt.
4. Remove the air conditioning and/or power steering pump drive belt.
5. Detach the by-pass hose from the water pump.
6. Unfasten the water pump retaining bolts and remove the water pump and fan assembly, using care not to damage the radiator with the fan.

To install:

7. Install the water pump and tighten the mounting bolts to 27 ft. lbs. (37 Nm). Always use a new gasket between the pump body and its mounting.
8. Install the drive belts and adjust the tension.
9. Refill the cooling system, start the engine and check for leaks.

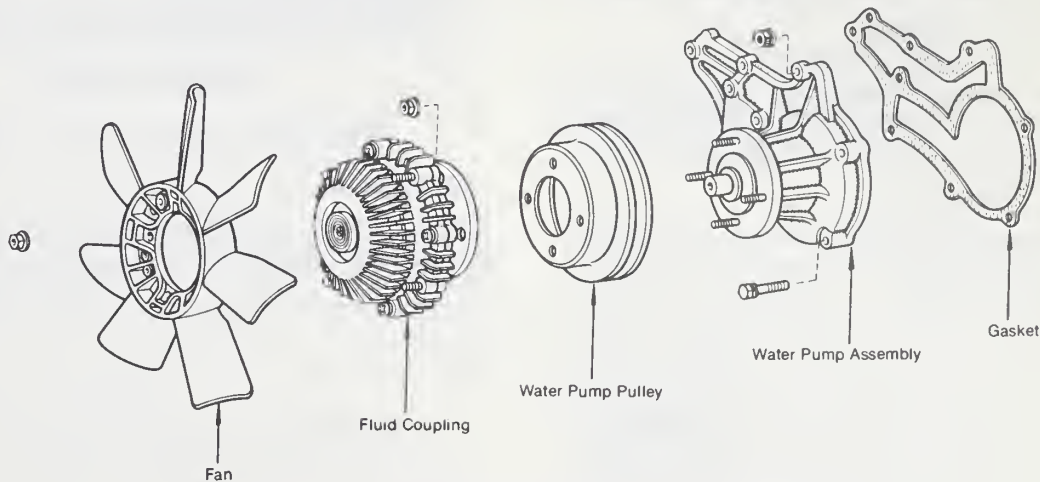
3F-E Engine

1. Drain the coolant from the engine and radiator.

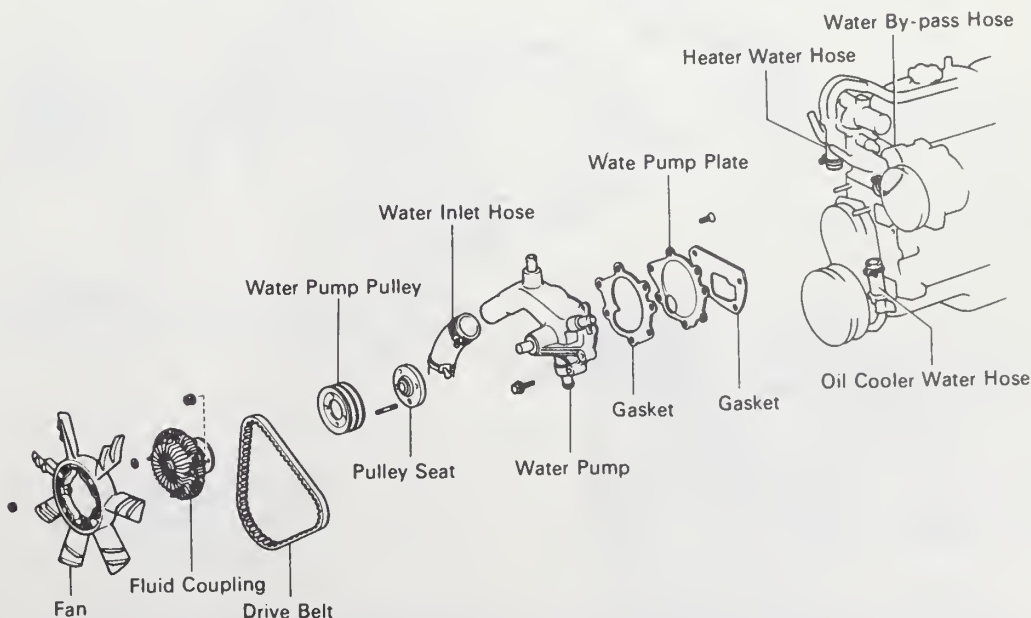
2. Remove the power steering belt.
3. Disconnect the coolant reservoir hose and disconnect the radiator inlet hose.
4. Remove the bolts holding the fan shroud.
5. Remove the alternator drive belt, fan, fluid coupling, and water pump pulley.
6. Remove the alternator.
7. Remove the air conditioning belt.
8. Disconnect the four hoses from the water pump.
9. Remove bolt, two nuts and power steering idler pulley with the bracket assembly.
10. Remove the bolt and nut, alternator support bracket, water pump and gasket.

To install:

11. Temporarily install a new gasket, the water pump and alternator support bracket with the bolt and nut.
12. Temporarily install the power steering idler pulley with the bracket assembly.
13. Tighten the water pump nuts and bolt to 27 ft. lbs. (37 Nm).



Water pump components for 4 cylinder engines



3F-E water pump components

3 ENGINE AND ENGINE OVERHAUL

14. Install the air conditioning belt and adjust it.
15. connect the hoses to the water pump.
16. Install the alternator.
17. Install the water pump pulley along with the fan and fluid coupling. Place the drive belt(s) onto each pulley; press down to tighten the belts against the pulley and tighten the four nuts. Adjust the belt tension.
18. Install the fan shroud bolts.
19. Attach the radiator inlet hose and connect the reservoir hose.
20. Install and adjust the power steering belt.
21. Install the proper amount of coolant in the system.
22. Start the engine and check for leaks.

3VZ-E Engines

WARNING: This procedure requires the removal of the timing belt. This is an extensive procedure requiring precision work, particularly at reassembly. Refer to **Timing Belt—Removal and Installation** in this Section. Do not attempt to remove the belt without consulting the procedure; extreme engine damage may occur.

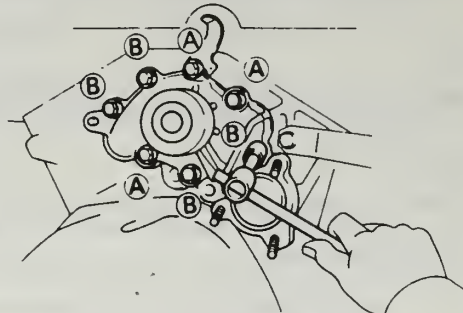
1. Drain the cooling system.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

2. Remove the timing belt.
3. Remove the No. 1 idler pulley.
4. Remove the thermostat.
5. Remove the seven bolts and the tension spring bracket and then remove the water pump.

6. Apply sealer to the pump-to-block mating surface and then tighten the bolts marked A in the illustration to 13 ft. lbs. (18 Nm). Tighten those marked B to 14 ft. lbs. (20 Nm).



Tighten the bolts correctly

7. Install the thermostat.
8. Install the idler pulley.
9. Install the timing belt.
10. Install the drive belts and adjust the tension.
11. Refill the cooling system and check for leaks.

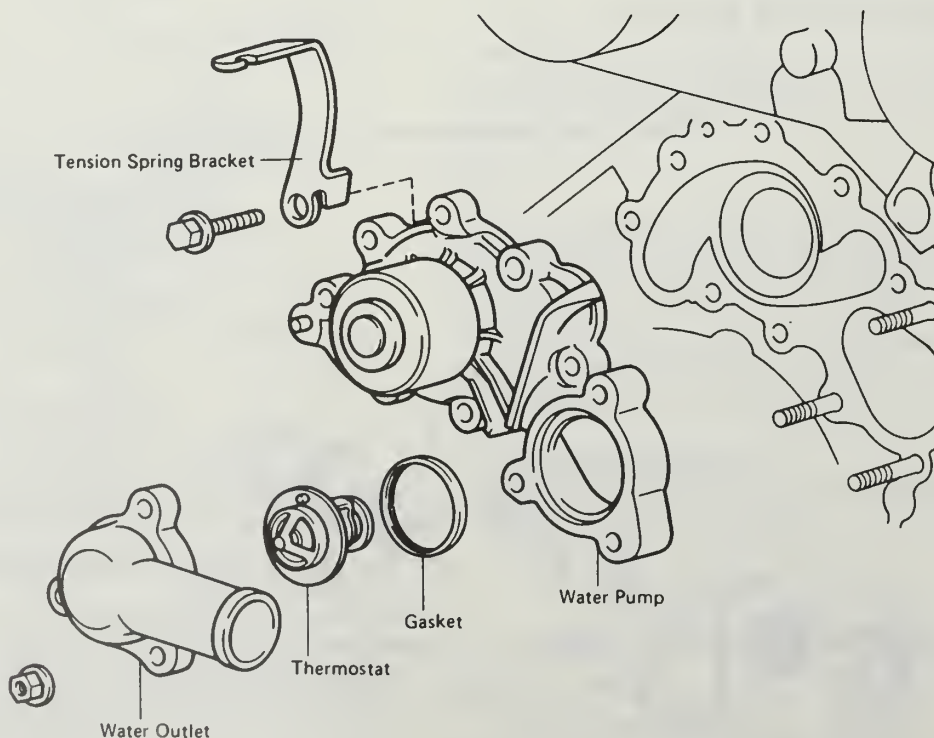
Cylinder Head

REMOVAL AND INSTALLATION

22R Engines

CAUTION

Do not perform this operation on a warm engine. Allow the engine to cool a minimum of 3 hours, more in hot weather. Overnight cold is best.



3VZ-E water pump. The timing belt must be removed before the water pump

1. Disconnect the negative battery cable.
2. Drain the cooling system (both radiator and block). If the coolant is to be reused, place a large, clean container underneath the drains.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

3. Remove the three exhaust pipe flange nuts and separate the pipe from the manifold.
4. Remove the air cleaner assembly, complete with hoses, from the carburetor.

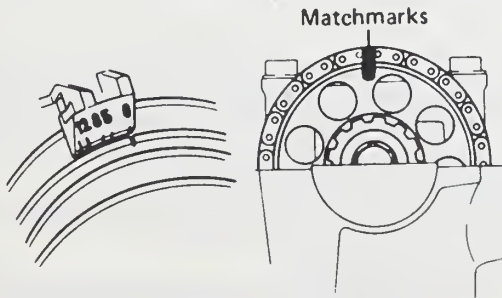
NOTE: Cover the carburetor with a clean shop cloth so that nothing can fall into it.

5. Drain the engine oil.

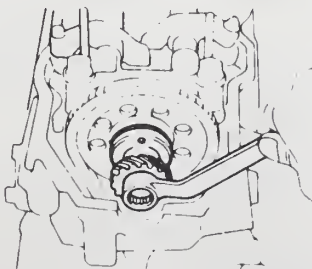
CAUTION

Used motor oil may cause skin cancer if repeatedly left in contact with the skin for prolonged periods. Although this is unlikely unless you handle oil on a daily basis, it is wise to thoroughly wash your hands with soap and water immediately after handling used motor oil.

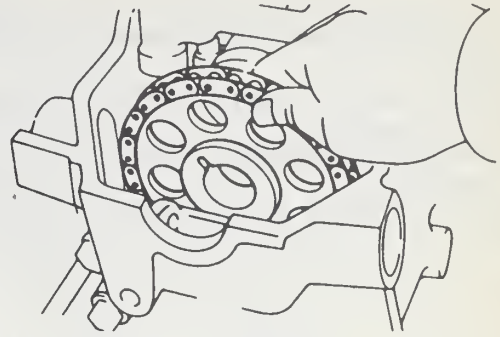
6. disconnect the radiator inlet hose from the water outlet.
7. If equipped with an air pump, disconnect the air hose from the check valve.
8. Disconnect the two heater hoses from the engine.
9. Disconnect the accelerator cable at the carburetor.
10. Label and disconnect these wires: EGR temperature sensor (Calif. vehicles only), water temperature gauge sender, cold mixture heater wire, temperature sensor, fuel cut solenoid valve and EACV (Calif. only).
11. Label and disconnect these hoses and lines: charcoal canister hose, brake booster hose, main fuel line from fuel inlet, fuel return line, HAC from the bracket, vacuum switch EBCV (Calif. vehicles) and VSV with bracket.
12. Remove the rear ground strap from the engine.
13. Remove the distributor. Remove the spark plugs.
14. Disconnect the power steering bracket from the head.
15. Remove the valve cover and gasket.



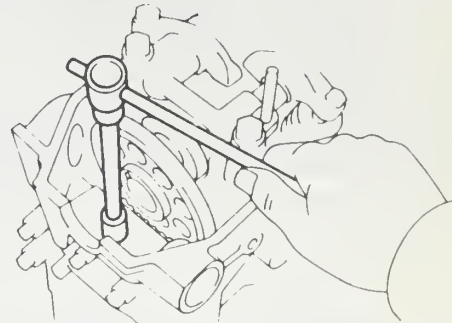
Set the timing marks to TDC/No.1 cylinder; matchmark the chain and sprocket



Use a 19mm wrench to remove the cam sprocket bolt

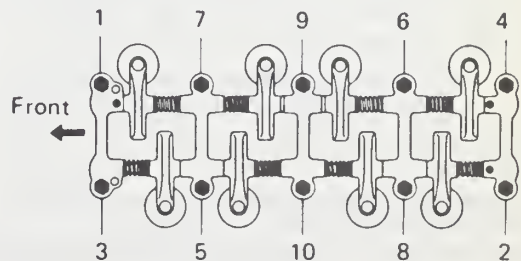


Do not allow the chain to slip off while removing the sprocket



Remove the front cover bolt before loosening the cylinder head bolts

16. Turn the engine clockwise (use the crank pulley bolt) until the No. 1 piston is at TDC on its compression stroke. Match mark the timing sprocket to the cam chain, and remove the semi-circular plug. Remove the cam sprocket bolt. Slide the distributor drive gear and spacer off the cam. Leave the chain on the sprocket; either wire the cam sprocket in place just off the end of the cam or rest the sprocket on the vibration damper.
17. Remove the timing chain cover bolt at the front of the head. This must be done before the head bolts are removed.



Loosen the head bolts in this order in three passes

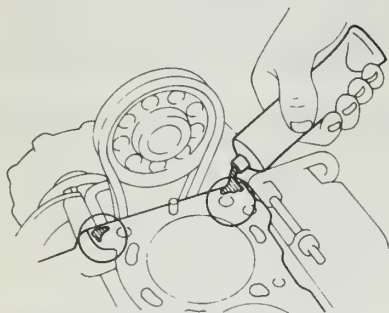
18. Remove the cylinder head bolts in the correct order. Make two or three passes to loosen the bolts. Do not loosen any one bolt all at once; improper removal could cause head damage.
19. Using pry bars applied evenly at the front and the rear of the valve rocker assembly, gently pry the assembly off its mounting dowels.
20. Lift the head off its dowels. If it is difficult to lift off, pry gently with small tools. Do NOT damage the mating surfaces of the head or block. Do NOT attempt to slide the head off the block; it must be lifted.
21. Support the head on a workbench.
22. Remove the manifolds and EGR valve from the head on the workbench. Keep the head covered and the manifold ports plugged with rags when not working on it.

3 ENGINE AND ENGINE OVERHAUL

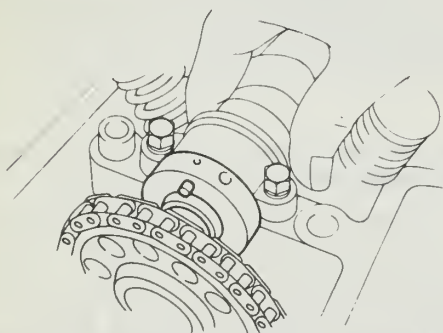
23. Re-drain the oil pan after the head has been removed; coolant will have spilled into the pan during head removal. The coolant will pollute the oil.

To install:

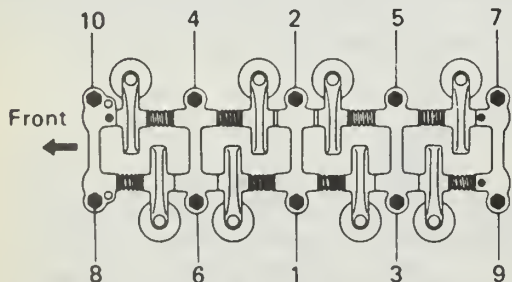
1. Apply liquid sealer to the front corners of the block and install the head gasket.
2. Lower the head over the locating dowels. Do not attempt to slide it into place.
3. Install the rocker arm assembly over its positioning dowels.



Apply liquid sealer to the corners of the block



Rotate the camshaft so that the pin is at the top



Cylinder head bolt tightening sequence—20R, 22R, 22R-E and 22R-TE engines

Tighten the head bolts in this order and in three passes

4. Install the cylinder head bolts. Tighten the bolts sequentially in three passes and in the correct order, coming to final torque on the last pass. Correct tightness is 58 ft. lbs. (78 Nm)
5. Install the chain cover bolt. Tighten it to 9 ft. lbs. (13 Nm).
6. Hold the chain and sprocket; double check that the engine is set to No. 1 TDC. If necessary, manually rotate the engine so that the sprocket hole is also at the top.
7. Fit the sprocket over the camshaft dowel. If the chain won't allow the sprocket to reach, rotate the crankshaft back and forth, while lifting up on the chain and sprocket.
8. Install the distributor drive gear and cam thrust plate over the chain sprocket; tighten the camshaft sprocket bolt to 58 ft. lbs. (78 Nm).

9. Set the No. 1 piston at TDC of its compression stroke and adjust the valves.
10. Apply sealant only the cylinder head side of the half-circle plug; install the plug.
11. Install the valve cover
12. Connect the power steering bracket and compressor support to the cylinder head. Tighten the bolts to 33 ft. lbs. (44 Nm)
13. Install the power steering belt and adjust the tension.
14. Install the distributor. Install the spark plugs.
15. Connect the rear ground strap.
16. Install the lines and hoses disconnected in Step 11 of Removal.
17. Connect the wires removed in Step 10 of Removal.
18. Connect the accelerator cable.
19. Connect the air pump hose to the check valve if it was removed.
20. Connect the 2 heater hoses and install the radiator hose to the water outlet.
21. Use a new gasket and connect the exhaust pipe to the manifold. New nuts are recommended.
22. Install the air cleaner and connect the hoses.
23. Refill the engine oil and engine coolant.
24. Double check all installation items, paying particular attention to loose hoses or hanging wires, untightened nuts, poor routing of hoses and wires (too tight or rubbing) and tools left in the engine area.
25. Connect the negative battery cable.
26. Start the engine, allowing it to idle and warm up gradually.
27. Shut the engine OFF. Readjust the valves.
28. Restart the engine and adjust the timing as necessary.
29. Recheck the fluid levels.
30. Road test the vehicle for general performance and drivability.

22R-E

CAUTION

Never perform this operation on a hot engine. Allow the engine to cool a minimum of 3 hours, more in hot weather. Overnight cold is best.

1. Disconnect the negative battery cable.
2. Drain the coolant from the radiator and the cylinder block. Drain the engine oil.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

3. Remove the air intake connector.
4. Disconnect the oxygen sensor wire.
5. Remove the three nuts attaching the manifold to the exhaust pipe and then separate the two.
6. Remove the oil dipstick.
7. Remove the distributor with the spark plug leads attached. Remove the spark plugs.
8. Disconnect the upper radiator hose and the two heater hoses where they attach to the engine and then position them out of the way.
9. Disconnect the actuator cable, the accelerator cable and the throttle cable for the automatic transmission at their brackets.
10. Tag and disconnect the following:
 - a. Both PCV vacuum hoses
 - b. Brake booster hose
 - c. Actuator hose (if equipped with cruise control)
 - d. Air control valve hoses (with power steering)
 - e. VSV hoses (with air conditioning)
 - f. EVAP hoses
 - g. EGR valve hose
 - h. fuel pressure hose

- i. Reed valve hose
- j. Pressure regulator hose
- k. Vacuum hoses from throttle body
- l. Water bypass hoses from throttle body
- 11. Tag and disconnect the EGR vacuum modulator hoses and then remove the modulator itself along with the bracket.
- 12. Disconnect the following wires:
 - a. Cold start injector pipe and wire
 - b. Throttle position sensor wire.
 - c. EGR temperature sensor (Calif. vehicles).
- 13. Disconnect the cold start injector pipe from the intake chamber. Remove the bolt holding the EGR pipe to the air chamber. Disconnect the chamber from the stay. Remove the air chamber-to-intake manifold bolts and then lift off the chamber with the throttle body, resonator and gasket.
- 14. Disconnect the fuel return hose.
- 15. Tag and disconnect the following wires:
 - a. Knock sensor
 - b. Oil pressure sender gauge or switch.
 - c. Starter wire
 - d. Transmission wires.
 - e. Compressor wires (with air conditioning)
 - f. Injector wires
 - g. water temperature sender gauge wire.
 - h. Overdrive temperature switch wire (auto. trans.)
 - i. Igniter wire.
 - j. VSV wires
 - k. Cold start injector time switch wire.
 - l. Water temperature sensor wire.
- 16. Disconnect the by-pass hose at the intake manifold.
- 17. If equipped with power steering, remove the pump and position it out of the way without disconnecting the hydraulic lines.
- 18. Remove the power steering bracket from the cylinder head.
- 19. Remove the cylinder head cover.

NOTE: Be sure to cover the oil return hole in the cylinder head with a clean rag to prevent anything from falling in.

- 20. Turn the engine clockwise (use the crank pulley bolt) until the No. 1 piston is at TDC on its compression stroke. Match mark the timing sprocket to the cam chain, and remove the semi-circular plug. Remove the cam sprocket bolt. Slide the distributor drive gear and spacer off the cam. Leave the chain or the sprocket; either wire the cam sprocket in place just off the end of the cam or rest the sprocket on the vibration damper.
- 21. Remove the timing chain cover bolt at the front of the head. This must be done before the head bolts are removed.
- 22. Remove the cylinder head bolts in the correct order. Make two or three passes to loosen the bolts. Do not loosen any one bolt all at once; improper removal could cause head damage.

NOTE: Refer to bolt removal diagram for 22R engine. All illustrations for 22R are valid for 22R-E.

- 23. Using pry bars applied evenly at the front and the rear of the valve rocker assembly, gently pry the assembly off its mounting dowels.
- 24. Lift the head off its dowels. If it is difficult to lift off, pry gently with small tools. Do NOT damage the mating surfaces of the head or block. Do NOT attempt to slide the head off the block; it must be lifted.
- 25. Support the head on a workbench.
- 26. Remove the manifolds and EGR valve from the head on the workbench. Keep the head covered and the manifold ports plugged with rags when not working on it.
- 27. Re-drain the oil pan after the head has been removed; coolant will have spilled into the pan during head removal. The coolant will pollute the oil.

To install:

- 1. Apply liquid sealer to the front corners of the block and install the head gasket.
- 2. Lower the head over the locating dowels. Do not attempt to slide it into place.
- 3. Install the rocker arm assembly over its positioning dowels.
- 4. Install the cylinder head bolts. Tighten the bolts sequentially in three passes and in the correct order, coming to final torque on the last pass. Correct tightness is 58 ft. lbs. (78 Nm)

NOTE: Refer to bolt tightening illustration with 22R head.

- 5. Install the chain cover bolt. Tighten it to 9 ft. lbs (13 Nm).
- 6. Hold the chain and sprocket; double check that the engine is set to No. 1 TDC. If necessary, manually rotate the engine so that the sprocket hole is also at the top.
- 7. Fit the sprocket over the camshaft dowel. If the chain won't allow the sprocket to reach, rotate the crankshaft back and forth, while lifting up on the chain and sprocket.
- 8. Install the distributor drive gear and cam thrust plate over the chain sprocket; tighten the camshaft sprocket bolt to 58 ft. lbs. (78 Nm).
- 9. Set the No. 1 piston at TDC of its compression stroke and adjust the valves.
- 10. Apply sealant only the cylinder head side of the half-circle plug; install the plug.
- 11. Install the valve cover
- 12. Attach the power steering bracket to the head; tighten the 4 bolts to 33 ft. lbs.(44 Nm).
- 13. Install the power steering pump and belt. Adjust the belt.
- 14. Connect the bypass hose to the intake manifold.
- 15. Connect the fuel hose to the delivery pipe. Tighten the bolt to 33 ft. lbs. (44 Nm).
- 16. Connect the wires removed in Step 15 of the removal procedure.
- 17. Connect the fuel return hose.
- 18. Position new gaskets on the intake manifold and EGR pipe. Install the air intake chamber, throttle body and resonator. Install the bolts holding the EGR valve to the chamber. Use a new gasket and install the cold start injector pipe.
- 19. Connect the throttle position wire, the cold start injector wire and the EGR temperature sensor wire (Calif. only)
- 20. Install the EGR vacuum modulator.
- 21. Connect the hoses removed in Step 10 of the removal procedure.
- 22. Connect the rear ground strap.
- 23. Connect the throttle and accelerator cables.
- 24. Install the heater hoses and the radiator inlet hose.
- 25. Install the spark plugs and the distributor. Install the engine oil dipstick.
- 26. Use new gaskets and connect the exhaust pipe to the manifold. Don't forget the clamp.
- 27. Install the air intake connector
- 28. Refill the engine oil and engine coolant.
- 29. Double check all installation items, paying particular attention to loose hoses or hanging wires, untightened nuts, poor routing of hoses and wires (too tight or rubbing) and tools left in the engine area.
- 30. Connect the negative battery cable.
- 31. Start the engine, allowing it to idle and warm up gradually.
- 32. Shut the engine OFF. Readjust the valves.
- 33. Restart the engine and adjust the timing as necessary.
- 34. Recheck the fluid levels.
- 35. Road test the vehicle for general performance and drivability.

3F-E Engines

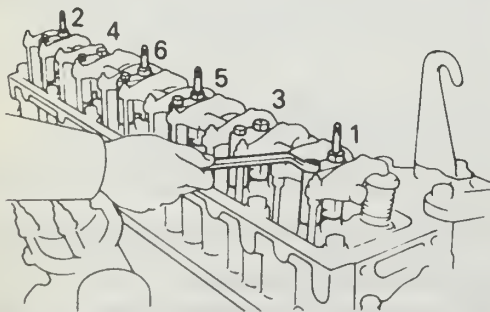
- 1. Drain the coolant.

3 ENGINE AND ENGINE OVERHAUL

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

2. Disconnect the negative battery cable.
3. Scribe matchmarks around the hood hinges and then remove the hood.
4. Disconnect the accelerator and throttle cables.
5. Remove the air intake hose, air flow meter and air cleaner cap. Disconnect the ISC hose, air pump hose, distributor hose and PCV hose. Remove the 3 hoses from the rear of the intake chamber and remove the 2 hoses from the charcoal canister vacuum valve.
6. Unbolt the power steering pump and position it out of the way without disconnecting the hydraulic lines.
7. Unbolt the air conditioning compressor and position it out of the way without disconnecting the refrigerant lines. Use stiff wire or string to support the compressor; do not allow it to hang by the hoses.
8. Remove the power steering pump and air conditioning compressor brackets.
9. Disconnect the high tension cords from the spark plugs and the coil.
10. Disconnect and remove the hoses from the water outlet, water pump, oil cooler and heater water pipe. Unbolt the oil cooler water pipe from the cylinder head.
11. Disconnect the upper radiator hose.
12. Disconnect and plug the fuel lines.
13. Raise the vehicle, making certain it is well supported. Disconnect the exhaust pipe at the manifold.
14. Remove the air pump.
15. Remove the fuel delivery pipe along with the fuel injectors.
16. Remove the air injection manifold.
17. Remove the intake and exhaust manifolds.
18. Disconnect the water by-pass hose at the water outlet and then remove the outlet assembly.
19. Remove the spark plugs.
20. Disconnect the water bypass hose from the water outlet. Remove the water outlet assembly.
21. Loosen the eight bolts and four nuts that attach the rocker shaft assembly in several stages and in the correct order. Remove the rocker shaft.



Loosen the 3F-E rocker assembly bolts in several passes in this order

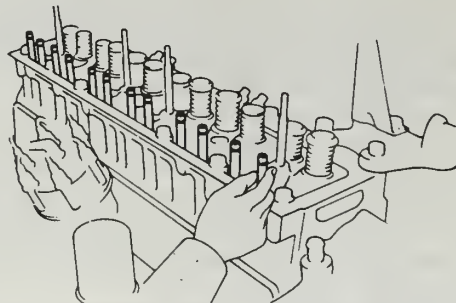
22. Remove the twelve pushrods—be sure they are kept in the order in which they were removed; they **MUST** be installed in the original locations. An upside-down box with holes punched in the bottom will make a good holder; number the holes to correspond with the pushrod position.

23. Loosen the cylinder head bolts in several stages and in the opposite order of the tightening sequence. Remove the air pump bracket and engine hanger.

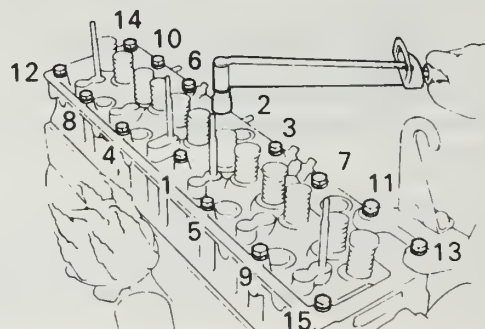
CAUTION

Removing the head bolts in the improper order could cause damage to the aluminum cylinder head.

24. Lift the cylinder head off of its mounting dowels. Do NOT attempt to slide the head off; it must be lifted. Support the head on a workbench.



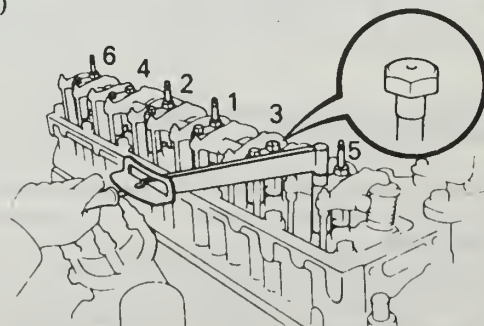
Remove the pushrods and keep them in order



This is the head bolt tightening sequence. For removal, begin with bolt No. 15, then 14, etc. Make three passes when loosening or tightening to prevent head damage

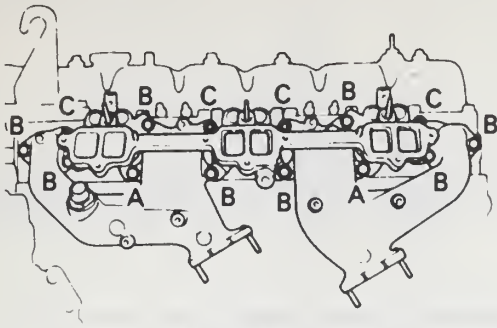
To install:

1. Install the cylinder head on the cylinder block using a new gasket.
2. Lightly coat the threads of the cylinder head bolts with engine oil and then install them into the head. Tighten them in several stages, in the order shown.
3. Install the pushrods in the order that they were removed.
4. Position the rocker shaft assembly on the cylinder head and align the rocker arm adjusting screws with the heads of the pushrods. Tighten the mounting bolts with a 12mm head to 17 ft. lbs. (24 Nm); tighten the bolts with a 14mm head to 25 ft. lbs. (33 Nm)



Tighten the valve train bolts in this order

5. Adjust the valve clearance and install the spark plugs.
6. Install the valve cover and tighten the cap nuts to 78 inch lbs. (8.8 Nm).
7. Install the water outlet and connect the by-pass hose. Tighten the bolts to 18 ft. lbs. (25 Nm).
8. Install the intake and exhaust manifolds using a new gas-



3F-E manifold bolts must be tightened correctly

ket. Make sure the front mark on the gasket is towards the front of the engine. Tighten the 17mm bolts (A) to 51 ft. lbs. (69 Nm). Tighten the 14mm bolts (B) to 37 ft. lbs. (50 Nm) and the nuts (C) to 41 ft. lbs. (56 Nm).

9. Install the heat insulators and the manifold stay. Tighten the manifold heat shield bolts to 9 Ft. lbs. (12 Nm) and the manifold support bolts to 22 ft. lbs (29 Nm).

10. Install the air injection manifold and tighten the union nuts and clamp bolts to 15 ft. lbs. (21 Nm).

11. Install the fuel injector/delivery pipe assembly.

12. Install the air pump and connect the air hose.

13. Connect the exhaust pipe to the manifold. Use a new gasket and tighten the bolts to 46 ft. lbs. (62 Nm).

14. Connect the fuel lines and the upper radiator hose.

15. Install the oil cooler pipe; connect the hoses to the water outlet, water pump, oil cooler and heater water pipe.

16. Connect the spark plug and coil wires.

17. Install the air conditioning compressor and the power steering pump. Adjust the belt tension; tighten the power steering pulley nut to 35 ft. lbs. (47 Nm).

18. Install the air intake hose, the air flow meter and the air cleaner cap. Connect the hoses removed during Step 5 of the removal procedure.

19. Connect and adjust the accelerator and throttle cables. Adjust them properly.

20. Refill the engine coolant.

21. Double check all installation items, paying particular attention to loose hoses or hanging wires, untightened nuts, poor routing of hoses and wires (too tight or rubbing) and tools left in the engine area.

22. Connect the negative battery cable.

23. Start the engine, allowing it to idle and warm up gradually.

24. Shut the engine OFF. Readjust the valves.

25. Restart the engine and adjust the timing as necessary.

26. Recheck the fluid levels.

27. Install the hood.

28. Road test the vehicle for general performance and drivability.

3VZ-E Engines

1. Disconnect the negative battery cable.

2. Remove the air cleaner hose and case.

3. Drain the engine coolant.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

4. Remove the radiator.

5. Unbolt the power steering pump and position it out of the way with the hoses still attached.

6. Remove the alternator drive belt; remove the fluid coupling and fan pulley.

7. Disconnect the following wires and connectors:

a. Ground strap from left fender apron

b. Alternator connector and wire.

c. Igniter connector.

d. Oil pressure switch connector.

e. Ground strap at rear of engine.

f. ECU connectors

g. VSV connectors.

h. Starter relay connector (manual trans. only)

i. Solenoid resistor connector

j. The check connector

k. Compressor connector

8. Disconnect the following hoses:

a. Power steering air hoses

b. Brake booster hose

c. Cruise control vacuum hose

d. Charcoal canister hose at the canister

e. VSV vacuum hose.

9. Disconnect the accelerator, throttle and cruise control cables.

10. Disconnect the clutch release cylinder hose (manual transmission only).

11. Disconnect the two heater hoses and the two fuel lines.

12. Remove the left side scuff plate (inside the left door). Disconnect the oxygen sensor. Disconnect the exhaust pipe at the manifold and at the catalytic converter. Remove the front exhaust pipe.

13. Remove the timing belt. Follow the procedure given later in this Section. This is a complicated operation requiring accurate work.

14. Remove the distributor with the spark plug leads attached; position it out of the way.

15. Remove the air intake chamber. Use the following procedure:

a. Disconnect the throttle position sensor connector

b. Disconnect the canister vacuum hose from the throttle body.

c. Disconnect the vacuum and fuel hoses from the pressure regulator.

d. Remove the PCV hose from the hose union.

e. Disconnect the water bypass hose from the intake manifold hose union.

f. Remove the water bypass hose from the water bypass pipe.

g. disconnect the cold start injector connector.

h. Disconnect the vacuum hose from the fuel filter.

i. Remove the union bolt and remove the cold start injector tube.

j. On California vehicles, disconnect the EGR temperature sensor.

k. Disconnect the EGR vacuum hoses from the air pipe and EGR vacuum modulator.

l. Remove the intake chamber support. Remove the two water hoses from the EGR valve if so equipped.

m. Remove the EGR valve with its pipes.

n. Remove the six bolts and two nuts; remove the intake air chamber.

16. Disconnect the following connectors. When all are released, remove the two bolts and remove the engine wire harness:

a. Knock sensor

b. No. 2 water temperature sensor

c. Cold start injector time switch connector

d. Water temperature sensor

e. Water temperature sender gauge connector

f. Right ground strap

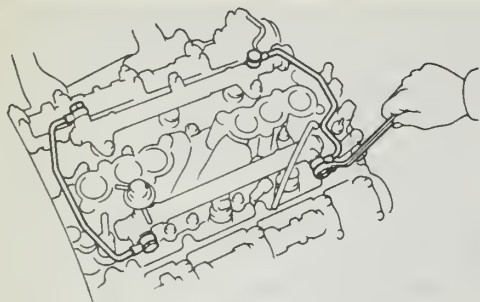
g. Injector connectors

17. Remove the Nos. 2 and 3 fuel pipes.

18. Remove the No. 4 timing belt cover.

19. Remove the No. 2 idler pulley and the No. 3 timing belt cover.

3 ENGINE AND ENGINE OVERHAUL



Removing fuel pipes No. 2 and 3

20. Remove the right side fuel delivery pipe (fuel rail) with the injectors.
21. Remove the left fuel delivery pipe and the injectors.
22. Disconnect the hose and remove the water by-pass outlet.
23. Remove the intake manifold.
24. Remove the knock sensor wire.
25. Remove the exhaust crossover pipe.

Right side:

26. Remove the reed valve with the No. 1 air injection manifold.
27. Remove the water by-pass pipe mounting bolt.
28. Remove the alternator.
29. Remove the right cylinder head cover.
30. Remove the two bolts and camshaft housing rear cover. Loosen each cam bearing cap bolt a little at a time and in the correct order. When all are loose, remove the bolts and remove the camshaft along with the oil seal and housing plug.
31. Loosen the cylinder head bolts in several stages, in the correct order.

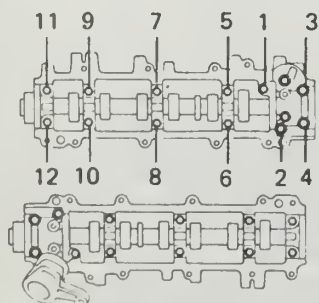
CAUTION

Removing the head bolts in the improper order could cause damage to the cylinder head.

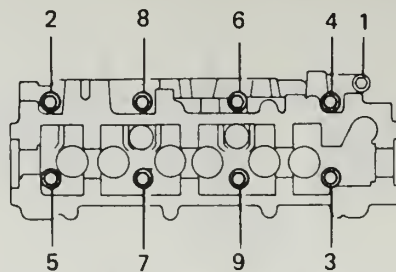
32. Lift the cylinder head off of its mounting dowels; do NOT attempt to slide it off. If the head is difficult to remove, gently pry with a small tool between the head and block projection. Take great care not to damage the mating faces of the block and/or head. Support the head on wooden blocks on the workbench.

Left side:

33. Remove the alternator.
34. Remove the oil dipstick. Remove the bolt and remove the dipstick guide tube.
35. Remove the left cylinder head cover.
36. Remove the two bolts and camshaft housing rear cover. Loosen each cam bearing cap bolt a little at a time and in the correct order. When all are loose, remove the bolts and remove the camshaft along with the oil seal and housing plug.
37. Loosen the cylinder head bolts in several stages, in the correct order.



Release the camshaft retaining bolts in this order



Remove the head bolts in this order-3VZ-E

CAUTION

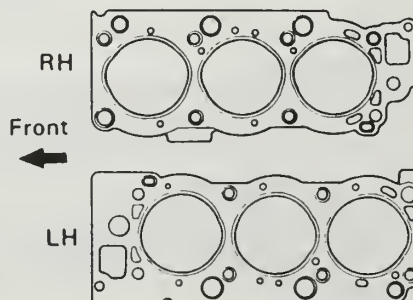
Removing the head bolts in the improper order could cause damage to the cylinder head.

38. Lift the cylinder head off of its mounting dowels; do NOT attempt to slide it off. If the head is difficult to remove, gently pry with a small tool between the head and block projection. Take great care not to damage the mating faces of the block and/or head. Support the head on wooden blocks on the workbench.

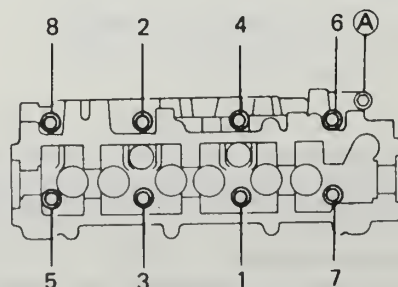
To install:

1. Install the cylinder head on the cylinder block using a new gasket.
2. Lightly coat the threads of the cylinder head bolts with engine oil and then install them into the head. Do not install bolt (A) at this time.

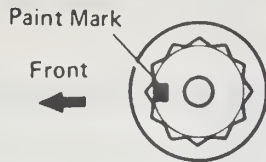
Tighten the bolts in several stages, in the order shown. After the initial tightening, mark the front side of the top of the bolt with paint. Tighten the bolts an additional 90° (¼ turn) and check that the mark is now facing the side of the head. Tighten the bolts an additional 90° and check that the mark is now facing the rear of the head. Install the bolt (A) and tighten it to 27 ft. lbs. (37 Nm).



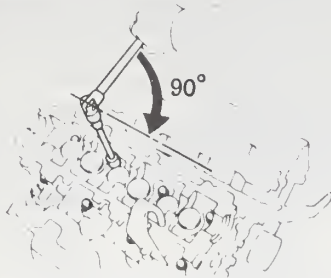
Correct position of 3VZ-E head gaskets



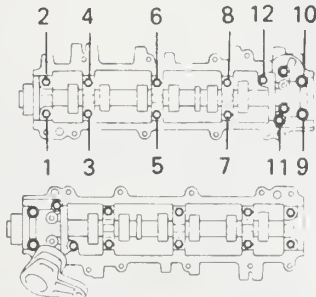
Tighten the cylinder head bolts in this order



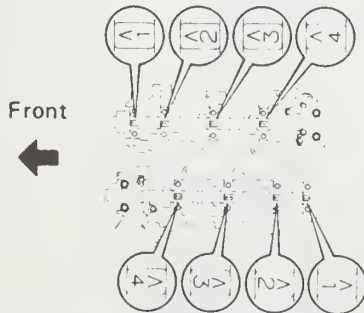
Use a small mark of paint on the bolt head after initial tightening



Turn the bolts **EXACTLY 90°** each time. Errors can be expensive



Bolt tightening sequence for camshaft bearing caps — 3VZ-E

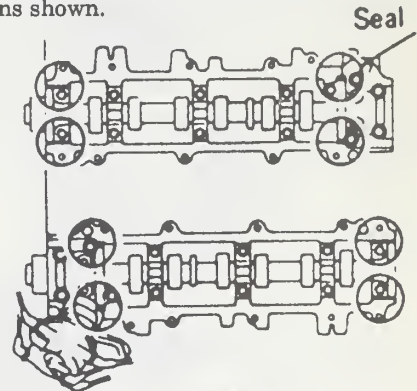


Camshaft bearing cap Installation — 3VZ-E

3. Install the camshaft. Install a new oil seal and install the camshaft housing plug.
4. Apply sealant to the Nos. 1 and 3 cam bearing caps. Place the caps on each journal with the arrows correctly aligned. On the right head, they should point to the front; on the left head, to the rear.
5. Temporarily tighten the bearing cap bolts just snug, a little at a time and in the correct order.
6. Use a seal driver of the correct diameter to install the oil seal. Use the same tool to install the camshaft housing plug.
7. Tighten the bearing caps to the correct torque. Make several passes and proceed in the proper order. Correct torque is 12 ft. lbs. (16 Nm).
8. Install the alternator and the water by-pass pipe mounting bolt.
9. Install the reed valve with the No. 1 injection manifold.

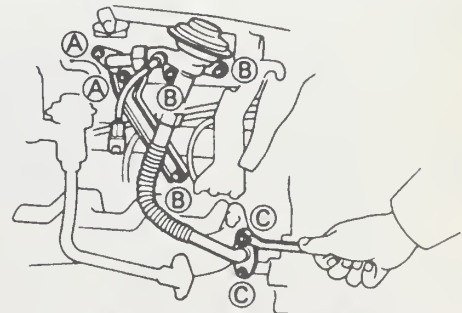
tighten the bolts to the cylinder head to 27 ft. lbs. (37 Nm); tighten the bolts to the exhaust manifold to 22 ft. lbs. (29 Nm).

10. Repeat installation Steps 1–8 for the opposite head if it was removed.
11. Install the oil dipstick tube.
12. Install the crossover pipe and tighten it to 29 ft. lbs. (39 Nm).
13. Connect the oxygen sensor wire.
14. Install the intake manifold with new gaskets and tighten the mounting bolts to 13 ft. lbs. (18 Nm).
15. Install the water by-pass outlet and tighten the two bolts to 13 ft. lbs. (18 Nm).
16. Install the fuel delivery pipes and injectors. Tighten the bolts to 9 ft. lbs. (13 Nm).
17. Install the No. 2 idler pulley. Install the Nos. 3 and 4 timing belt covers and tighten the bolts to 74 inch lbs. (8.3 Nm).
18. Install the No. 4 timing belt cover.
19. Install the fuel pipes and tighten the union bolts to 22 ft. lbs. (29 Nm).
20. Install the timing belt.
21. Check and adjust the valve clearance.
22. Install the cylinder head covers. Apply sealant to the head in the locations shown.



Apply sealant in each of these areas before installing the valve cover

23. Install the engine wire harness and secure the two bolts.
24. Connect the wires and connectors removed during removal Step 16.
25. Install the air intake chamber and tighten the nuts and bolts to 13 ft. lbs. (18 Nm).
26. Install the EGR valve and connect all hoses and lines. Install and tighten the bolts and nuts correctly. A: 9 ft. lbs. (12 Nm), B: 13 ft. lbs. (18 Nm) and C: 22 ft. lbs. (29 Nm).



Tighten each group of bolts correctly

27. Install the distributor and spark plug wires.
28. Install the front exhaust pipe, using new gaskets. Connect the oxygen sensor and replace the left sill plate.
29. Connect the fuel lines and heater hoses.
30. Connect the clutch release cylinder hose (manual trans. only.)
31. Install the power steering pump.

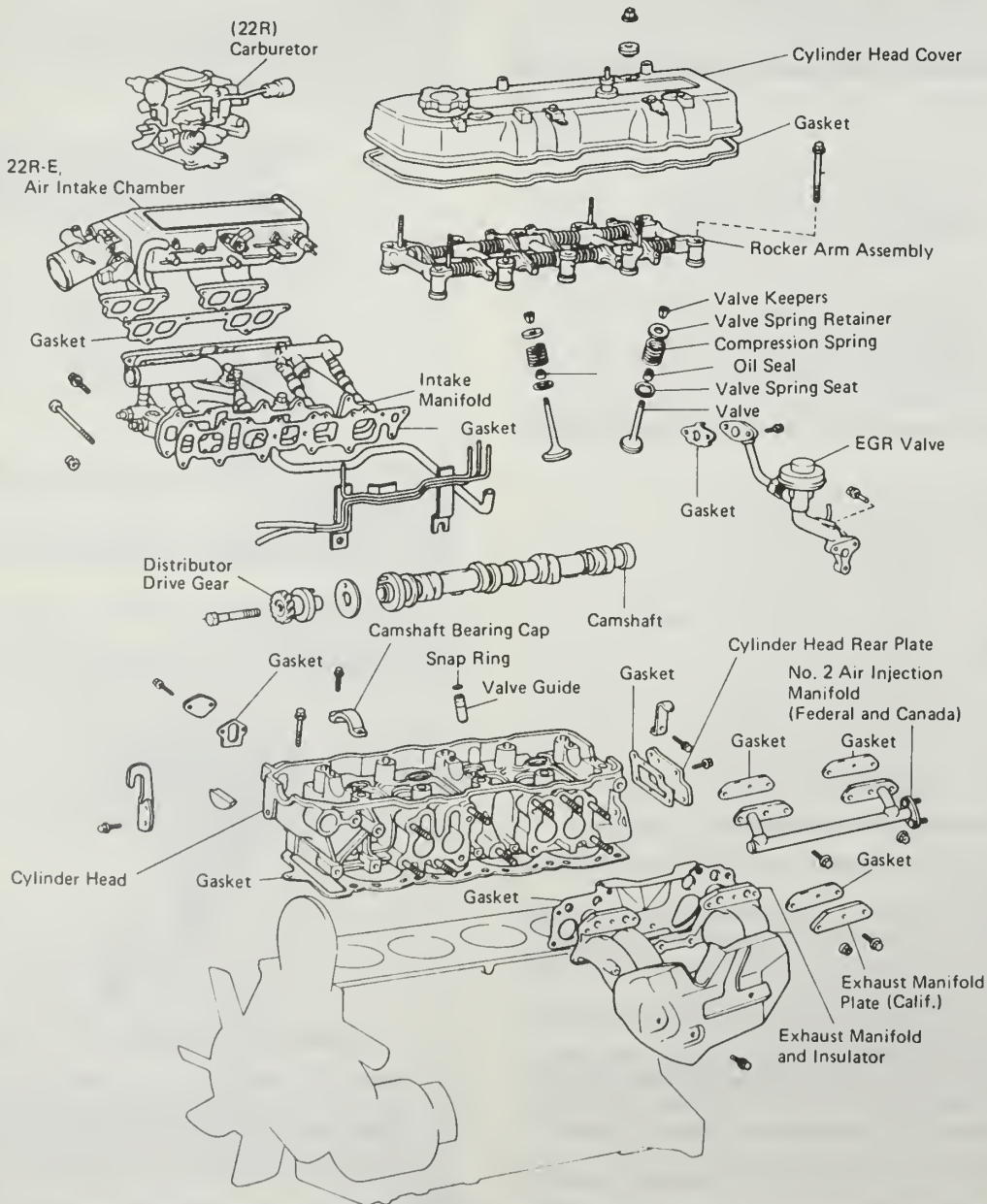
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44. Road test the vehicle for general performance and driveability.
45. Check and adjust fluid levels.

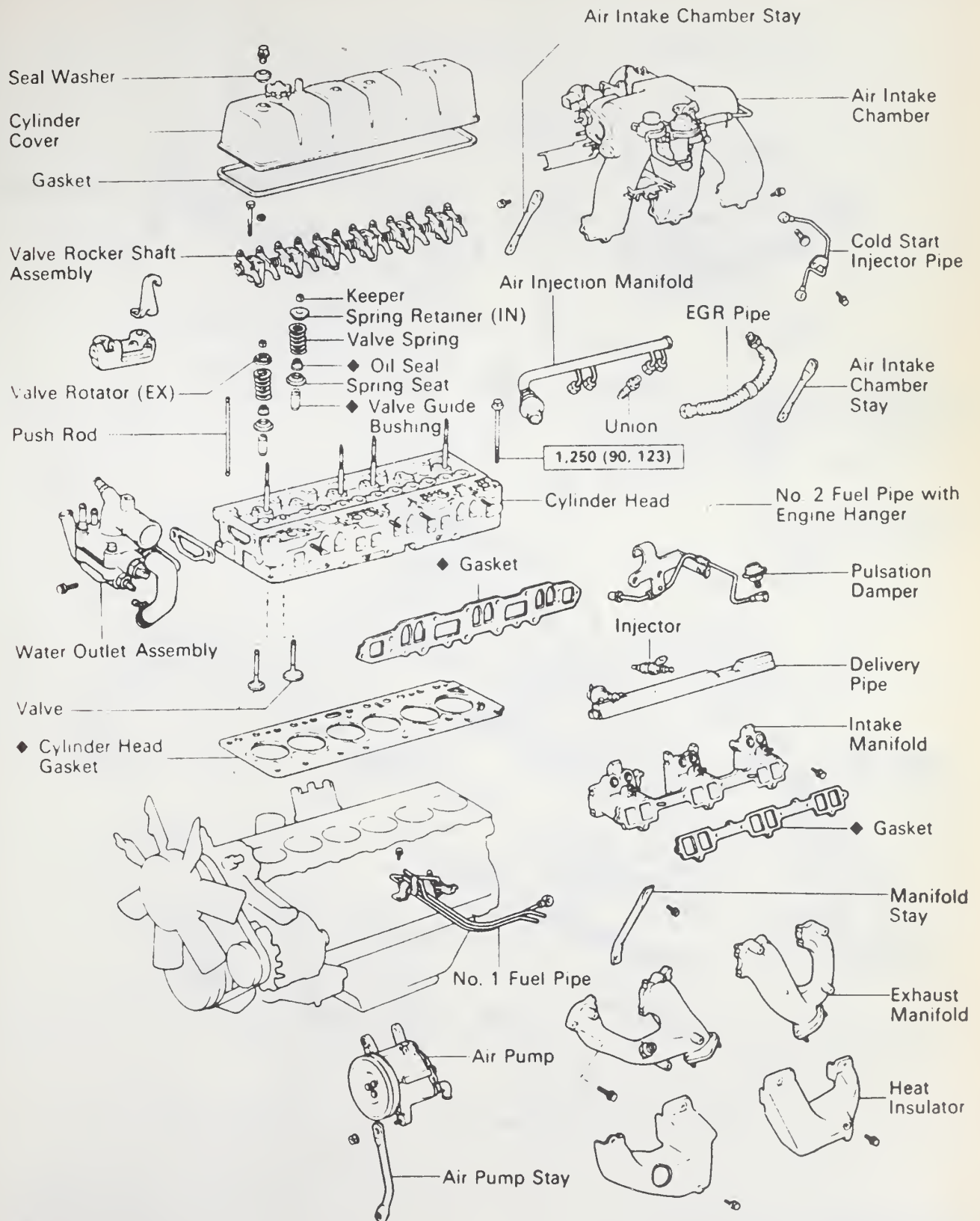
CLEANING AND INSPECTION

Using a wire brush attached to your electric drill, remove the carbon in each combustion chamber. Make sure the brush is actually removing the carbon and not merely burnishing it.

Clean all the valve guides using a valve guide brush (available

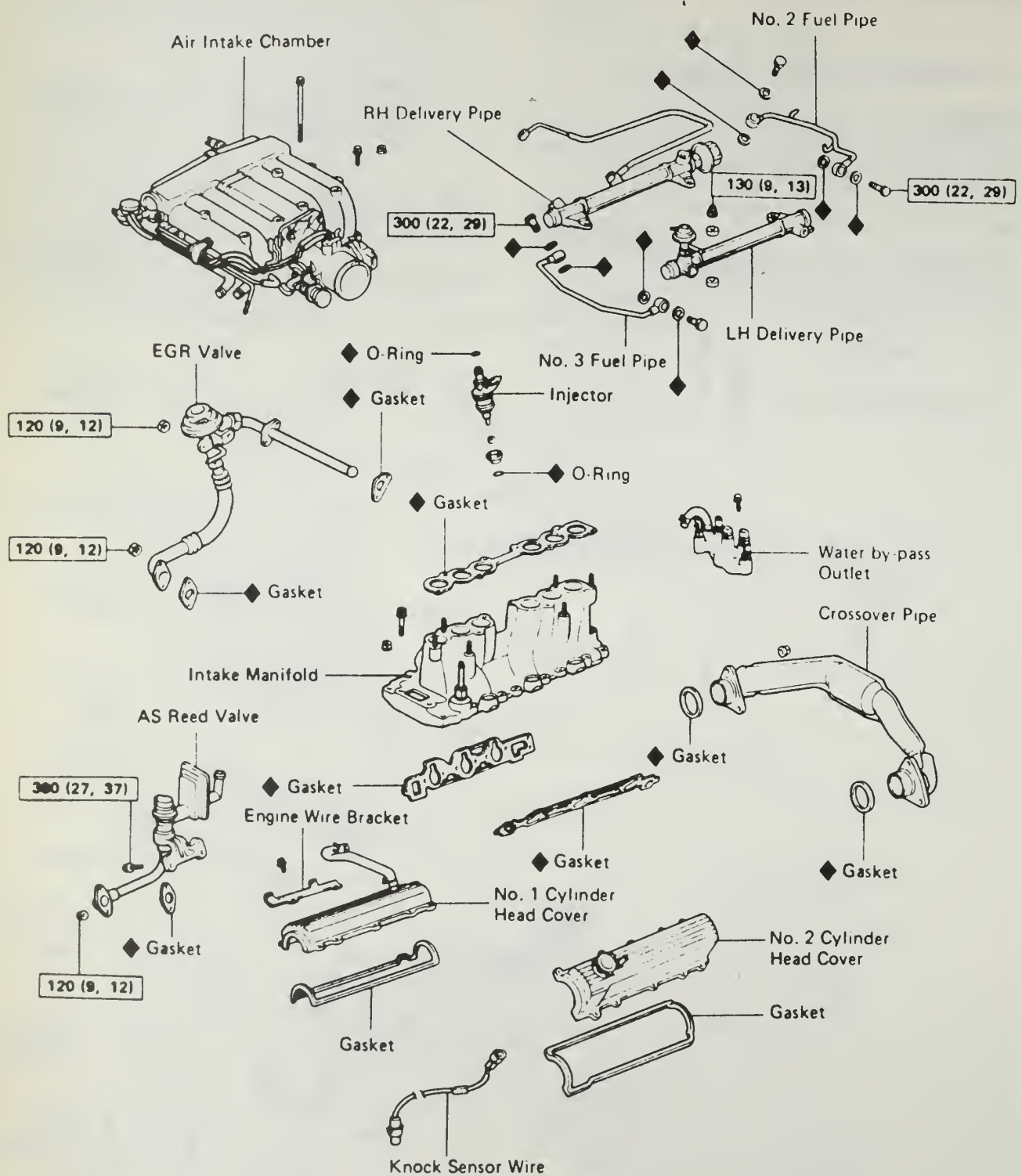


Cylinder head components — 22R and 22R-E. Gaskets must not be reused



Cylinder head components — 3F-E

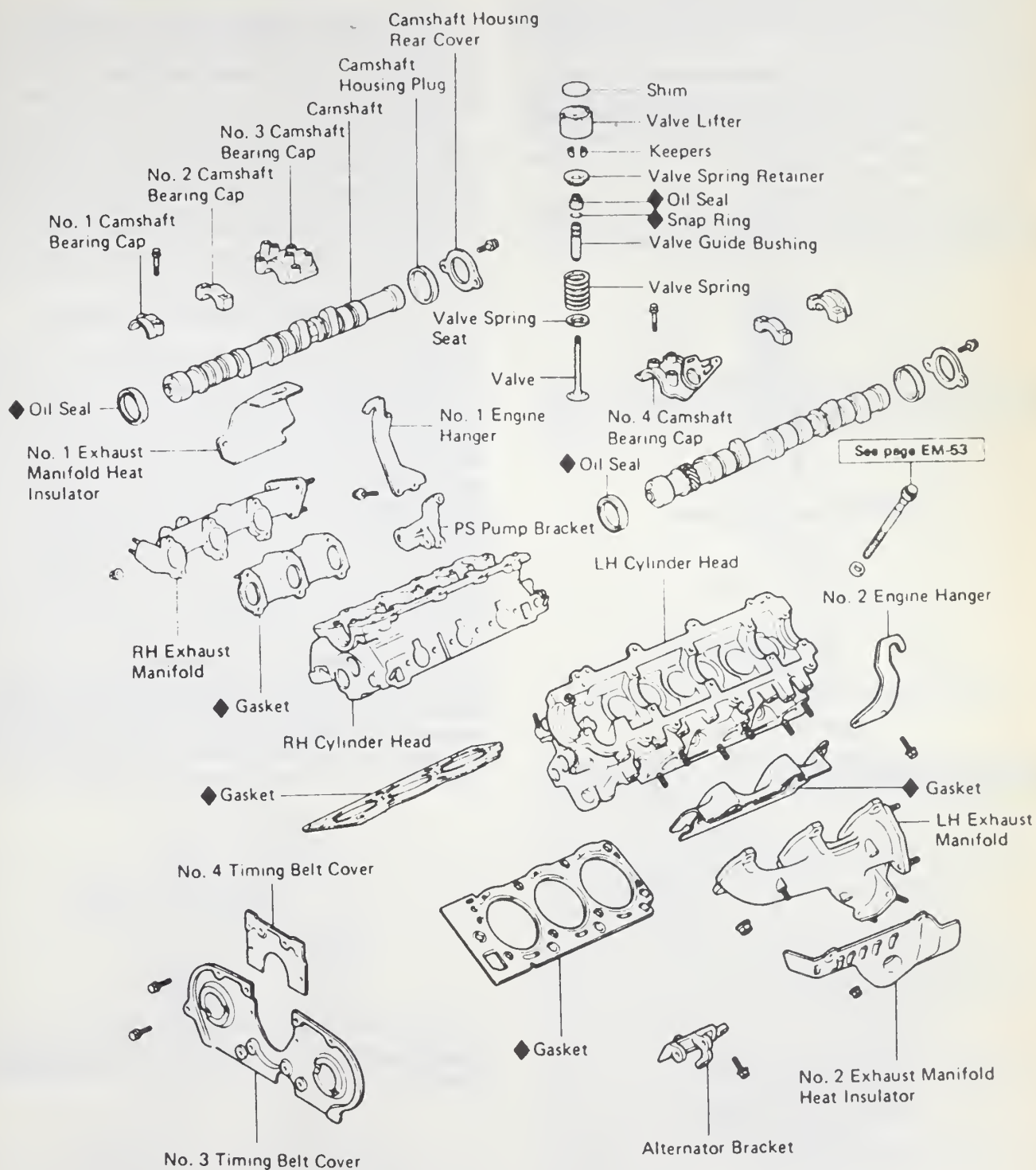
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kg-cm (ft-lb, N-m) : Specified torque

◆ Non-reusable part

Upper half of 3VZ-E cylinder head components



kg-cm (ft-lb, N.m) : Specified torque

◆ Non-reusable part

Lower half of 3VZ-E cylinder head components

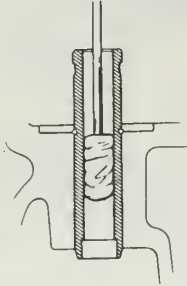
3 ENGINE AND ENGINE OVERHAUL

at most auto parts or auto tool shops) and solvent. A fine-bristled rifle bore cleaning brush also works here.

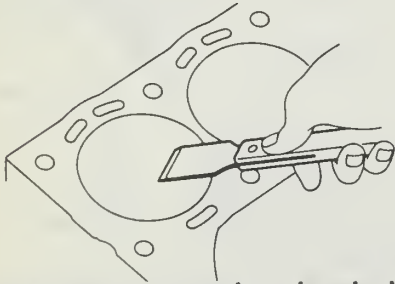
Inspect the threads of each spark plug hole by screwing a plug into each, making sure it screws down completely. Heli-coil® any plug hole that is damaged.

WARNING: You may wish to send the bare head to a machine shop for cleaning. There are many ways to clean the head including solvent baths and glass bead blasting. **DO NOT** hot tank the cylinder head. The head material on most engines is aluminum, which is ruined if subjected to the hot tank solution.

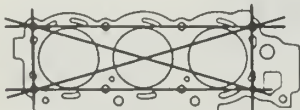
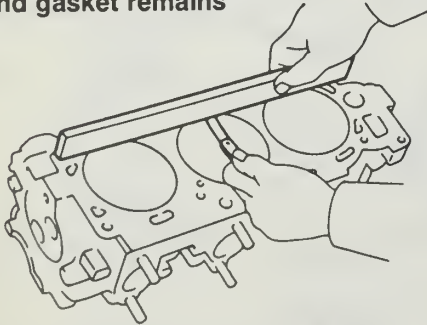
Finally, go over the entire head with a clean shop rag soaked in solvent to remove any grit, old gasket particles, etc. Blow out the bolt holes, coolant galleys, intake and exhaust ports, valve guides and plug holes with compressed air.



Cleaning the valve guides



Scrape the piston tops and engine deck to remove carbon and gasket remains



Using the straight-edge to measure warpage on head, block and manifold surfaces. 3VZ-E shown, procedure similar for all engines

RESURFACING

While the head is removed, check the head-to-block mating surface for straightness. If the engine has overheated and blown a head gasket, this must be done as a matter of course. A warped mating surface must be resurfaced (milled); this is done by a machine shop on a milling machine and is quite similar to planing a piece of wood.

Using a precision steel straight-edge and a blade-type feeler gauge, check the surface of the head across its length, width and diagonal length. Also check the intake and exhaust manifold mating surfaces and cam cover mating surfaces. If warpage exceeds 0.010mm (0.0039 in), the head must be replaced. Warpage under this amount allows resurfacing, if done carefully.

If the head is sent out for resurfacing, have it crack checked at the same time. The few dollars extra is worth the peace of mind.

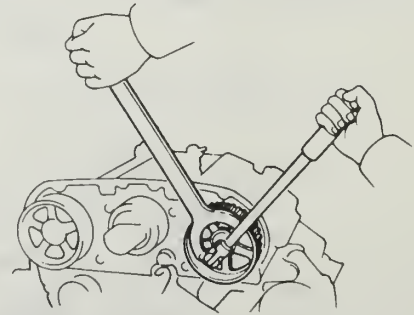
CYLINDER BLOCK CLEANING

While the cylinder head is removed, the top of the cylinder block and pistons should also be cleaned. Before you begin, rotate the crankshaft until one or more pistons are flush with the top of the block (on the four cylinder engines, you will either have Nos. 1 and 4 up, or Nos. 2 and 3 up). Carefully stuff clean rags into the cylinders in which the pistons are down. This will help keep grit and carbon chips out during cleaning. Using care not to gouge or scratch the block-to-head mating surface and the piston top(s), clean away any old gasket material with a wire brush and/or scraper. On the piston tops, make sure you are actually removing the carbon and not merely burnishing it.

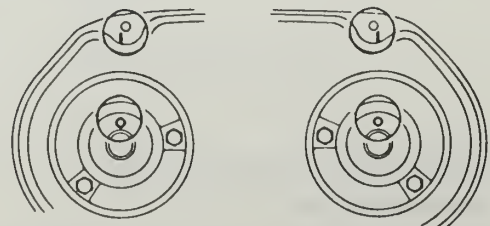
Remove the rags from the down cylinders after you have wiped the top of the block with a solvent soaked rag. Rotate the crankshaft until the other pistons come up flush with the top of the block, and clean those pistons.

NOTE: Because you have rotated the crankshaft, you will have to re-time the engine following the procedure listed under the Timing Chain/Timing Belt removal.

Make sure you wipe out each cylinder thoroughly with a solvent-soaked rag, to remove all traces of grit, before the head is reassembled to the block. Any particles trapped by the piston will score the cylinder wall.



Always correctly hold the pulley when loosening or tightening



Before installing the 3VZ-E cam pulleys, the pin holes must be aligned with the upper timing marks

Valves and Springs

REMOVAL AND INSTALLATION

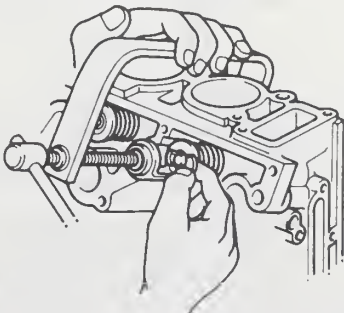
A valve spring compressor is needed to remove the valves and springs; these are available at most auto parts and auto tool shops. A small magnet is very helpful for removing the keepers and spring seats.

Set the head on its side on the bench. Install the spring compressor so that the fixed side of the tool is flat against the valve head in the combustion chamber, and the screw side is against the retainer. Slowly turn the screw in towards the head, compressing the spring. As the spring compresses, the keepers will be revealed; pick them off of the valve stem with the magnet as they are easily fumbled and lost. When the keepers are removed, back the screw out and remove the retainers and springs. Remove the compressor and pull the valves out of the head from the other side. Remove the valve seals by hand and remove the spring seats with the magnet.

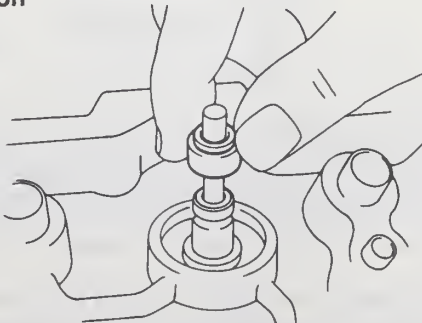
Since it is very important that each valve and its spring, retainer, spring seat and keepers is reassembled in its original location, you must keep these parts in order. The best way to do this is to cut either eight (for four cylinder) or twelve (for six cylinder) holes in a piece of heavy cardboard or wood. Label each hole with the cylinder number and either **IN** or **EX**, corresponding to the location of each valve, intake or exhaust, in the head. As you remove each valve, insert it into the holder, and assemble the seats, springs, keepers and retainers to the stem on the labeled side of the holder. This way each valve and its attendant parts are kept together, and can be put back into the head in their proper locations.

After lapping each valve into its seat (see Valve Lapping, below), oil each valve stem, and install each valve into the head in the reverse order of removal, so that all parts except the keepers are assembled on the stem. Always use new valve stem seals.

NOTE: Some 3F-E engines use valve rotators in place of the spring retainer. These disassemble and reassemble in the same fashion but use different valve keepers. The keepers are not interchangeable.

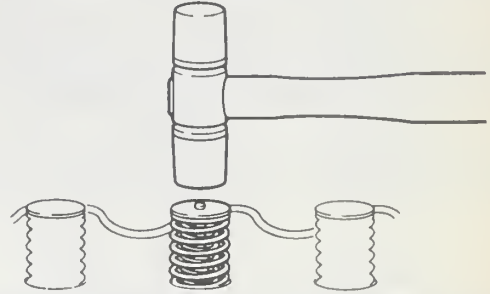


After compressing the valve springs, keep careful track of the small keepers; they are easily fumbled into oblivion



Always install new valve stem seals

Install the spring compressor, and compress the retainer (or rotator) and spring until the keeper groove on the valve stem is fully revealed. Coat the groove with a wipe of grease (to hold the keepers until the retainer is released) and install both keepers, wide end up. Slowly back the screw of the compressor out until the spring retainer covers the keepers. Remove the tool. Lightly tap the end of each valve stem with a rubber hammer to ensure proper fit of the retainers and keepers.



Lightly tap each assembled valve with a plastic mallet. The light tap flexes the valve spring to reveal any mounting problems. Watch for keepers that may fall out

w/ Spring Retainer



w/ Valve Rotator



Don't interchange the 3F-E valve keepers

INSPECTION

Before the valves can be properly inspected, the stem, lower end of the stem and the entire valve face and head must be cleaned. An old valve works well for chipping carbon from the valve head, and a wire brush, gasket scraper or putty knife can be used for cleaning the valve face and the area between the face and lower stem. Do not scratch the valve face during cleaning. Clean the entire stem with a rag soaked in thinners to remove all varnish and gum.

Thorough inspection of the valves requires the use of a micrometer, and a dial indicator is needed to measure the inside diameter of the valve guides. If there instruments are not available to you, the valves and head can be taken to a reputable machine shop for inspection. Refer to the Valve Specifications chart for valve stem and stem-to-guide specifications.

If the above instruments are at your disposal, measure the diameter of each valve stem at the top, middle, and bottom of the stem. Measure in two dimensions (when viewed from the top of the stem). This is six measurements per valve; jot these measurements down in order for each valve.

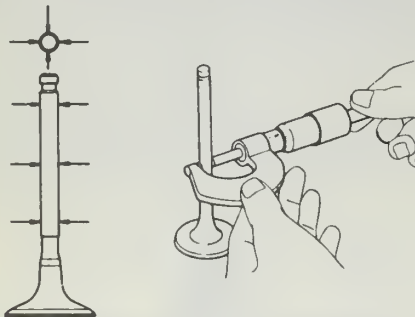
Using the dial indicator, measure the inside diameter of the valve guides at their bottom, top and midpoint, again in two dimensions. Six measurements for each guide; jot these measurements down also.

Subtract the valve stem measurement from the valve guide inside measurement; if the clearances exceed that listed in the specifications chart under Stem-to-Guide Clearance, replace the valve(s). Stem-to-guide clearance can also be checked at a machine shop, where a dial indicator would be used.

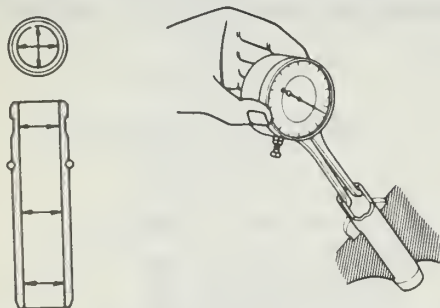
Check the top of each valve stem for pitting, mushrooming and unusual wear due to improper rocker adjustment, etc. The

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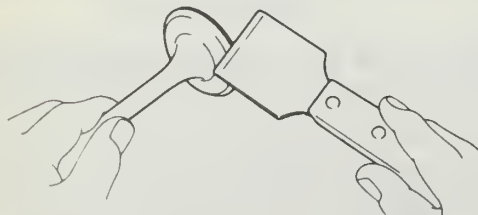
stem tip can be ground flat if it is worn, but no more than 0.50mm can be removed; if this limit must be exceeded to make the tip flat and square, then the valve must be replaced. If the valve stem tips are ground, make sure you fix the valve securely into a jig designed for this purpose, so the tip contacts the grinding wheel squarely at exactly 90°. Most machine shops that handle automotive work are equipped for this job.



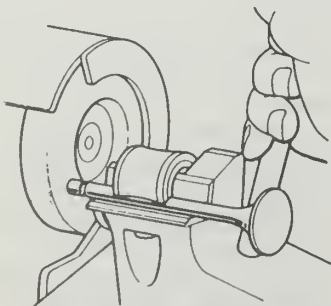
Use the micrometer to measure the valve stem at 6 locations



Use a dial gauge to check valve guide diameter at 6 locations



Carefully scrape carbon from the valve head



If the head is ground, it must be held at exactly 90°
REFACING

Valve refacing should only be handled by a reputable machine shop, as the experience and equipment needed to do the job are beyond that of the average owner/mechanic. During the course of a normal valve job, refacing is necessary when simply lapping the valves into their seats will not correct the seat and face wear.

When the valves are reground (resurfaced), the valve seats must also be recut, again requiring special equipment and experience.

VALVE LAPPING

The valves must be lapped into their seats after resurfacing, to ensure proper sealing. Even if the valves have not been refaced, they should be lapped into the head before reassembly. Lapping is nothing more than very fine metal polishing to get an accurate match between two contacting surfaces.

Set the cylinder head on the workbench, combustion chamber side up. Rest the head on wooden blocks on either end, so there are 2-3 in. (51-76mm) between the tops of the valve guides and the bench.

1. Lightly lube the valve stem with clean engine oil. Coat the valve seat completely with valve grinding compound. Use just enough compound that the full width and circumference of the seat are covered.

2. Install the valve in its proper location in the head. Attach the suction cup end of the valve lapping tool to the valve head. It usually helps to put a small amount of saliva into the suction cup to aid it sticking to the valve.

3. Rotate the tool between the palms, changing position and lifting the tool often to prevent grooving. Lap the valve until a smooth, evenly polished seat and valve face are evident.

4. Remove the valve from the head. Wipe away all traces of grinding compound from the valve face and seat. Wipe out the port with a solvent-soaked rag, and swab out the valve guide with a piece of solvent-soaked rag to make sure there are no traces of compounding grit inside the guide. This cleaning is important. If not removed, the compound will continue to grind components inside the engine while running.

5. Lap each remaining valve, one at a time. Make sure the valve faces, seats, cylinder ports and valve guides are clean before reassembling the valve train.

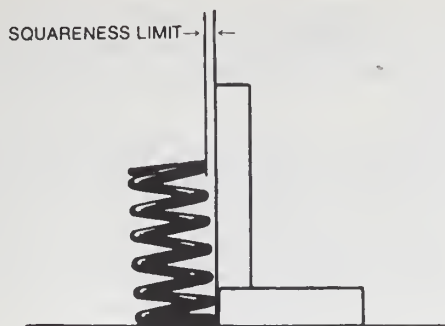


Lapping a valve is simple, but necessary

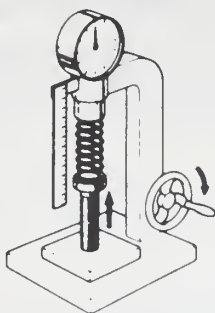
Valve Springs INSPECTION

Valve spring squareness, length and tension should be checked while the valve train is disassembled. Place each valve spring on a flat surface next to a steel square. Measure the length of the spring, and rotate it against the edge of the square to measure distortion. If spring length varies (by comparison) by more than 1.6mm or if distortion exceeds 1.6mm, replace the spring.

Spring tension must be checked on a spring tester. Springs used on most Toyota engines should be within one pound of each other when tested at their specified installed heights.



Check each spring for height and squareness



A special testing tool is needed to check spring compression

Valve Seats

The valve seats in the engines covered in this guide are all non-replaceable, and must be recut when service is required. Seat recutting requires a special tool and experience, and should be handled at a reputable machine shop. Seat concentricity should also be checked by a machinist.

Valve Guides

INSPECTION

Valve guides should be cleaned as outlined earlier, and checked when valve stem diameter and stem-to-guide clearance is checked. Generally, if the engine is using oil through the guides (assuming the valve seals are OK) and the valve stem diameter is within specification, it is the guides that are worn and need replacing.

Valve guides which are not excessively worn or distorted may, in some cases, be knurled rather than replaced. Knurling is a process in which metal inside the valve guide bore is displaced and raised (forming a very fine cross-hatch or spiral pattern), thereby reducing clearance. Knurling also provides for excellent oil control. The possibility of knurling rather than replacing the guides should be discussed with a machinist.

REMOVAL AND INSTALLATION

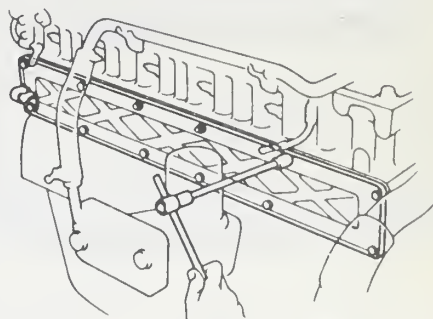
Valve guide replacement on all Toyota engines requires breaking off the top end of the guides, heating the cylinder head to almost 200°F, then driving the rest of the guide out of the head with a hammer and drift. Unless you and your family don't mind baking an oily cylinder head in the oven (and probably smelling it in the house for months), take the head to a machine shop and have a machinist replace the guides.

Valve Lifters

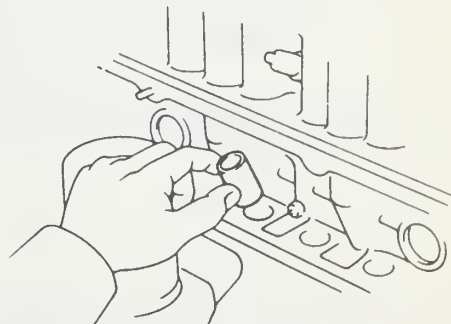
Only the 3F-E engine uses valve lifters. These are cylindrical

devices between the bottom of the pushrod and the lobe of the camshaft. The lifter follows the motion of the camshaft lobe, meeting it with a broad smooth face. The pushrod would not stay in place on the cam lobe if the lifter were not present. To remove the lifters:

1. Remove the valve rocker shaft assembly and pushrods, following procedures outlined in this section.
2. Remove the pushrod cover, the long panel on the side of the engine block.
3. Remove the lifters, keeping them in order. The surfaces of the lifter have become matched to the respective cam lobe and pushrod; interchanging will increase wear. Some of the lifters will be down inside the bores; a magnetic finger tool will be useful.
4. Clean each lifter thoroughly. Use a micrometer to measure lifter diameter. Standard diameter is 21.387mm–21.404mm (0.8420–0.8427 in.).



Remove the pushrod cover on 3F-E



Some lifters can be removed by hand; others will need a magnetic finger

To install:

5. Install the lifters in their correct location. A light coat of clean oil is helpful. Make certain the lifters are not upside down.
6. Install a new pushrod cover gasket and install the cover. Tighten the nuts and bolts to 35 inch lbs. (4 Nm). This is little more than finger tight; do not overtighten.
7. Install the rocker shaft assembly.

Oil Pan

REMOVAL AND INSTALLATION

1. Elevate the front of the vehicle and support it securely on stands.
2. Remove the undercover from the engine. Drain the oil.

CAUTION

Used motor oil may cause skin cancer if repeatedly left in contact with the skin for prolonged periods. Although this is unlikely unless you handle oil on a daily basis, it is wise to thoroughly wash your hands with soap and water immediately after handling used motor oil.

3. If the truck or 4Runner is 4WD, remove the front differential. Removal is not required on Land Cruiser.

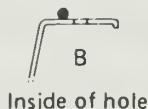
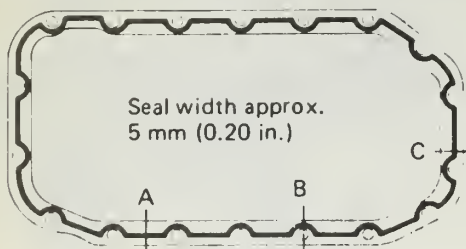
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4. For 22R and 22R-E engines, remove the engine mounting bolts. Position a floor jack under the transmission and raise the engine/transmission assembly slightly.

5. Remove the oil pan bolts and remove the oil pan. If the pan is difficult to remove do NOT pry with screwdrivers or similar tools; the flange of the pan will be deformed. Tap the bottom or side of the pan with a wooden or plastic mallet to dislodge the pan from the block. If this is still not sufficient, make a wooden wedge and gently tap it into the seam.

6. Use a razor blade to scrape the cylinder block and oil pan mating surfaces clean of any old sealing material. All traces of the old gasket and sealer must be removed.

7. Clean the pan thoroughly, using solvent if necessary. If the pan has a magnet in it, examine the catchings closely; excess metal is a sign of excess engine wear. A few slivers are normal. Use good judgment in relating the amount of debris to the amount of time the pan has been in place.



The bead of sealant must be correctly placed. If the bead is too large, it can plug passages; if too narrow, it won't seal properly.

NOTE: Do not use a solvent which will affect the paint on the pan. Flecks of paint remaining in the pan can plug the oil pick-up or dissolve in the oil, polluting it.

To install:

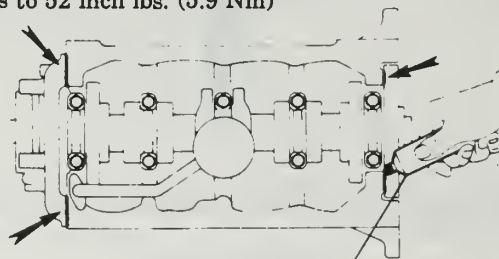
8. On 22R, 22R-E and 3VZ-E engines, the pan does not use a pre-made gasket; all sealing is accomplished by correct application of sealant from a tube. Cut the tip of the tube to produce a bead about 1/4 in. (6mm) only. Place the continuous bead of sealant in the groove, looping to the inside of the bolt holes and keeping about 1/4 in. (6mm) from the edge of the pan.

9. On 3F-E, install a new gasket on the pan without sealant.

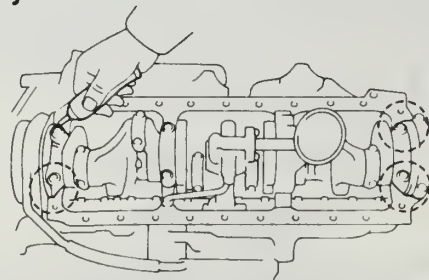
10. For 22R, 22R-E and 3F-E, apply sealant to the 4 points on the cylinder block at the chain cover and rear oil seal retainer.

11. Install the pan to the block within about 5 minutes of applying the sealer and install the retaining bolts and nuts finger tight.

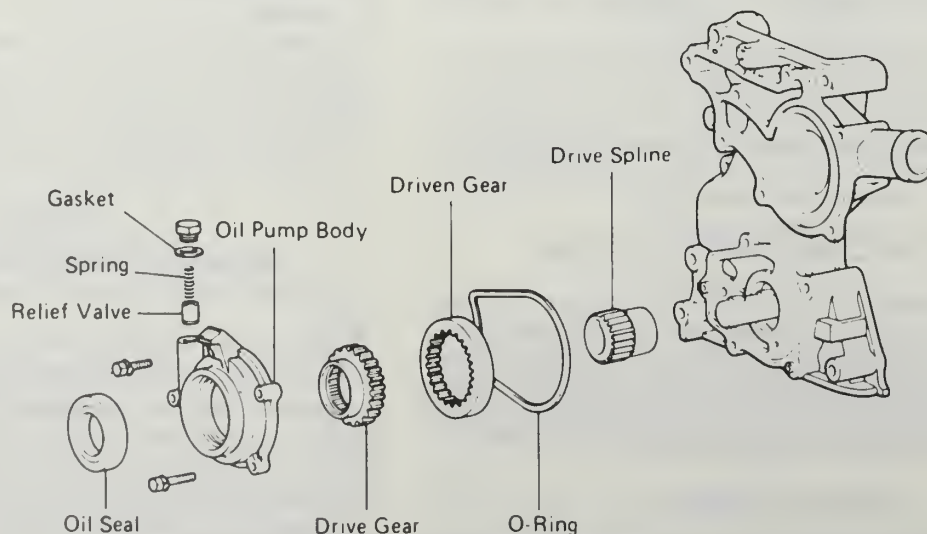
12. Tighten the nuts and bolts, working from the center of the pan in a circular pattern to the ends. For 22R and 22R-E, tighten the fittings to 9 ft. lbs. (13 Nm); for 3VZ-E engines, tighten the fittings to 52 inch lbs. (5.9 Nm)



Also apply sealant here on the 22R and 22R-E block



3F-E oil pans require sealant on the block, not on the pan



22R and 22R-E oil pump components

13. For 22R and 22R-E engines, lower the engine/transmission into place and install the motor mount bolts.

14. Double check the oil drain plug. Make certain it is present and correctly tightened in the pan.

15. Install engine oil.

16. Install the front differential if it was removed.

17. Install the engine undercover.

18. Lower the vehicle to the ground. Start the engine and check for leaks.

19. Road test the vehicle and, upon returning, check for leaks. Inspect oil level and adjust if necessary.

Oil Pump

REMOVAL AND INSTALLATION

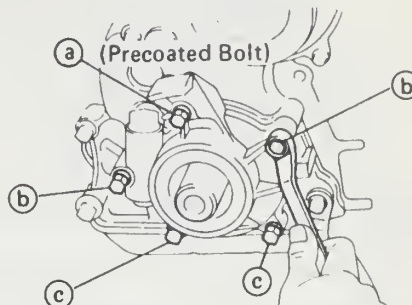
22R and 22R-E Engines

1. Remove the oil pan.
2. Remove the four bolts holding the oil strainer.
3. Remove the drive belts.
4. Remove the crankshaft pulley.
5. If equipped with air conditioning, remove the compressor and its bracket. Support the compressor out of the way with the hoses attached. Do not discharge the system or loosen the compressor lines.
6. Loosen the oil pump relief valve bolt.
7. Remove the five retaining bolts and remove the oil pump assembly with the O-ring.
8. Remove the oil pump drive spline from the crankshaft.

To install:

9. Slide the pump drive spline onto the crankshaft. Place a new O-ring in the groove.
10. Clean the threads of the upper retaining bolt of all grease, oil or debris. Clean all the bolts holes.
11. Apply sealant to the first 2 or 3 threads of the upper bolt. Install all the bolts. Tighten each to the correct tightness. Bolt

(a): 18 ft. lbs. (25 Nm); bolts (b) 14 ft. lbs. (19 Nm) and bolts (c) 9 ft. lbs. (13 Nm).

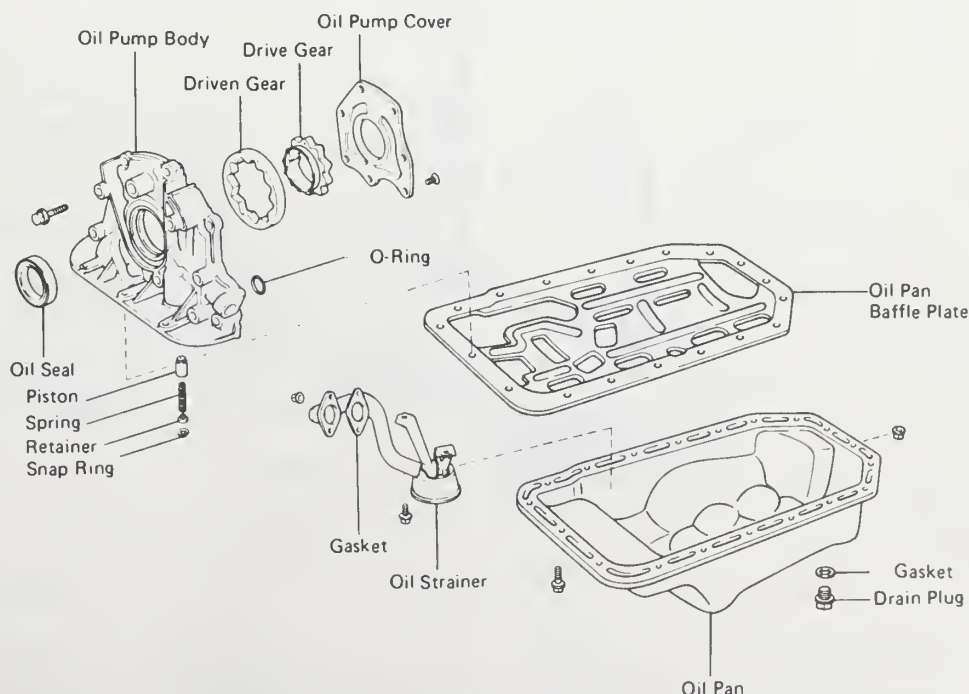


22R/22R-E oil pump bolts must be tightened correctly. The upper bolt must have sealant placed on the first few threads

12. Install and tighten the relief valve plug to 27 ft. lbs. (37 Nm).
13. Install the crankshaft pulley.
14. Install the drive belts and adjust them correctly.
15. Install the oil strainer. Make sure it has been thoroughly cleaned. Install a new gasket and tighten the bolts to 9 ft. lbs. (13 Nm).
16. Install the oil pan.

3VZ-E Engines

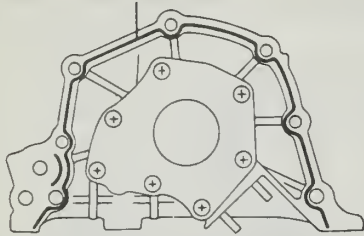
1. Remove the engine under cover.
2. Remove the front differential.
3. Drain the oil.
4. Remove the timing belt.
5. Remove the crankshaft timing pulley.
6. Raise the engine slightly and remove the oil pan.



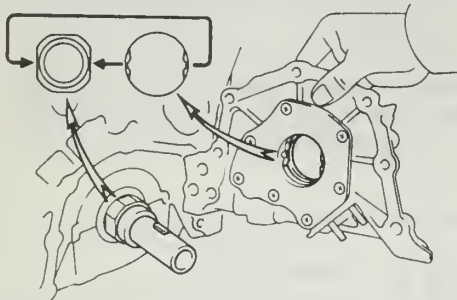
3VZ-E oil pump components

3 ENGINE AND ENGINE OVERHAUL

Seal Packing



Carefully apply sealant to the 3VZ-E oil pump. Too much can block an oil passage



Make certain the oil pump drive is correctly aligned before installing the 3VZ-E oil pump

7. Remove the two bolts and nuts; remove the oil strainer and gasket.

8. Insert a drift between the cylinder block and the oil pan baffle plate, cut off the sealer and remove the baffle plate.

NOTE: When removing the baffle plate with the drift, do not damage the baffle plate flange.

9. Remove the seven bolts and remove the oil pump and O-ring. If the pump is difficult to remove, use a small plastic mallet to carefully tap (tap!) the body of the oil pump.

To install:

10. Apply sealer to the oil pump mating surface, running the bead on the inside of the bolt holes. Position a new O-ring in the groove in the cylinder block and install the pump so that the spline teeth of the drive gear engage the large teeth on the crankshaft. Tighten the mounting bolts to 14 ft. lbs. (20 Nm).

11. Remove any old sealer on the baffle plate and block surfaces. If solvent is used, make sure it does not affect the paint. Dry the surfaces completely. Apply sealant in a 3mm bead around the baffle. Run the bead to the inside of the bolt holes and avoid excess sealant.

12. Install the baffle plate.

13. Install the oil strainer and tighten the bolts to 61 inch lbs. (7 Nm).

14. Install the oil pan.

15. Install the crankshaft pulley.

16. Install the timing belt.

17. Install the front differential and the undercover.

18. Fill the engine with oil and check for leaks.

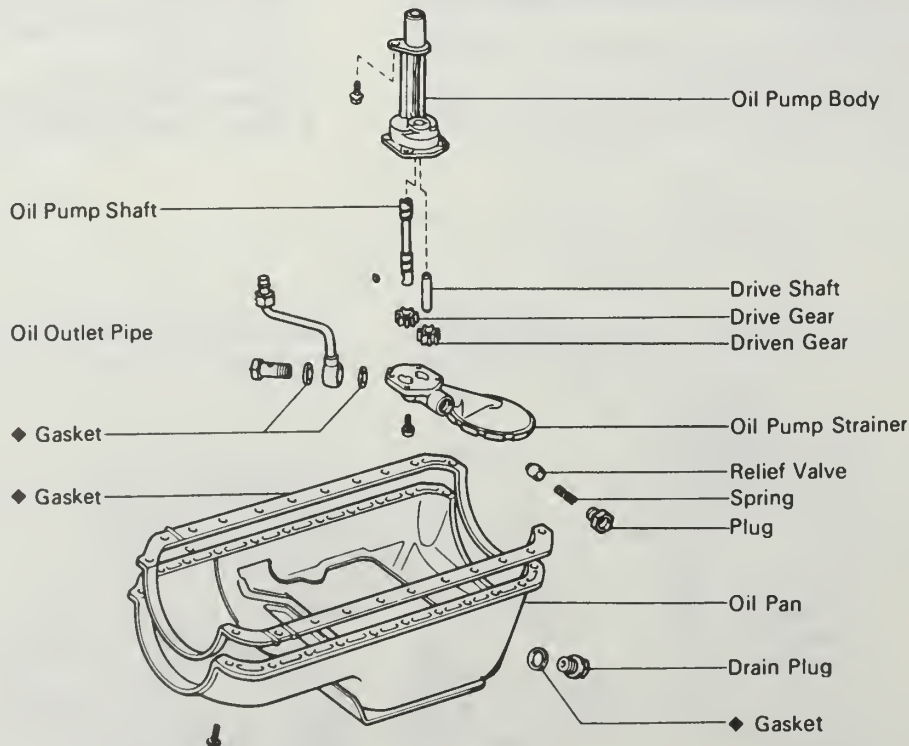
3F-E Engines

1. Remove the oil pan.

2. Remove the oil outlet pipe.

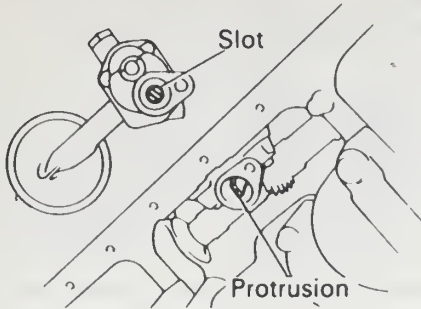
3. Remove the oil pump retaining bolt(s) and nuts; remove the strainer and gasket.

4. Remove the retaining bolt and remove the oil pump. Re-



◆ Non-reusable part

Oil pump components, 3F-E



The oil pump drive must be correctly installed before installation

move the oil pump cover and inspect the following parts for nicks, scoring, grooving, etc.:

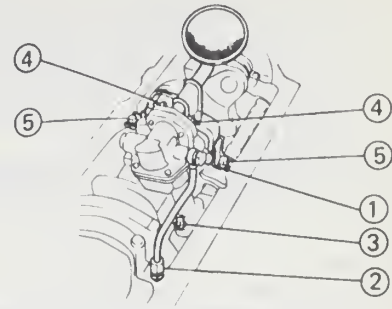
To install:

5. Install the oil pump so that the slot in the oil pump shaft is in alignment with the protrusion on the governor shaft of the distributor. Tighten the mounting bolts just snug.

6. Use new gaskets. Install the outlet pipe and strainer, again tightening the bolts just snug.

7. Torque the nuts and bolts in the order shown. When tightening the oil strainer nuts (4) press the strainer onto the cylinder block so there is no gap between the strainer and block. Use the illustration and tighten the nuts and bolts: (1) and (2), 33 ft. lbs. (44 Nm); (3), 13 ft. lbs. (18 Nm); (4), 10 ft. lbs. (13 Nm) and (5), 13 ft. lbs. (18 Nm).

8. Install the oil pan, fill the engine with oil and check for leaks.



All 3F-E nuts and bolts must be tightened in the correct order

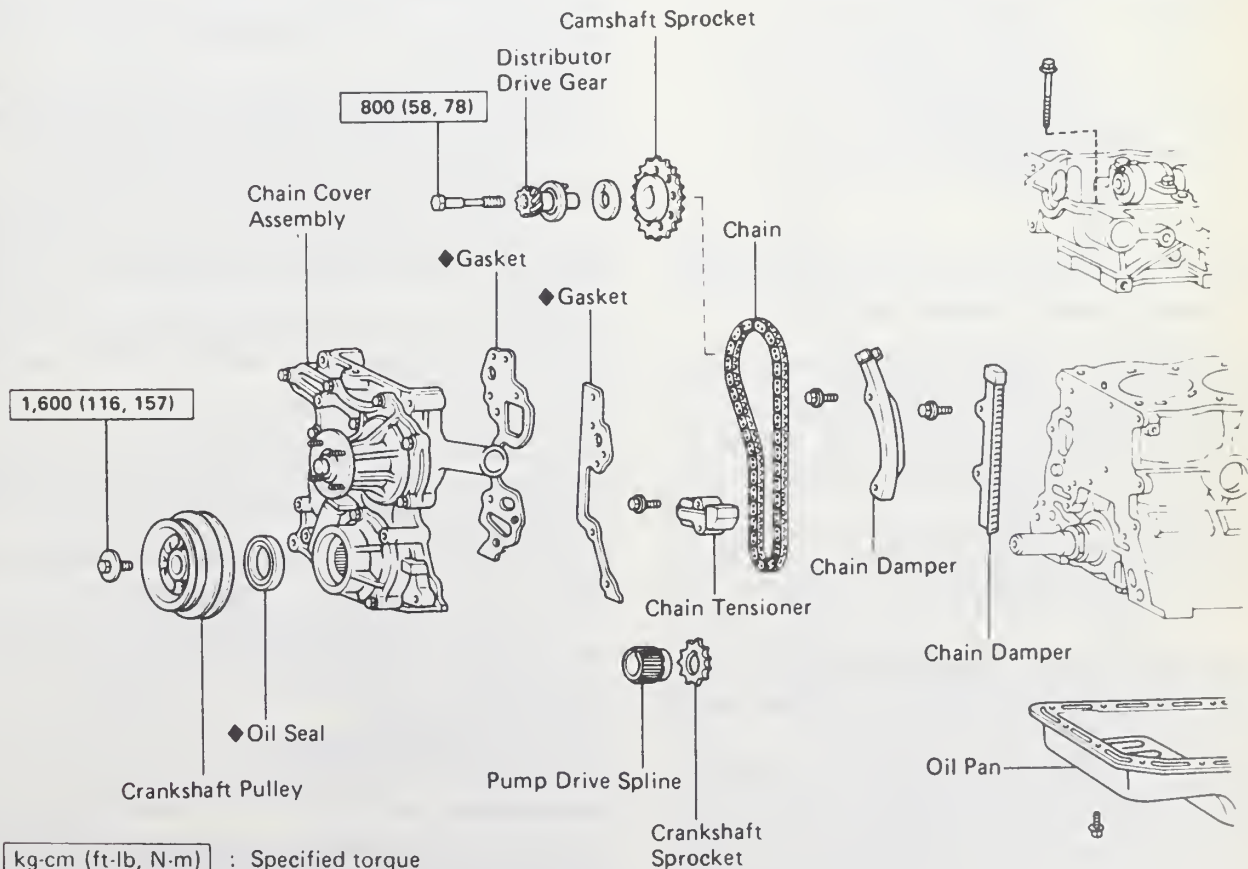
Timing Chain/Timing Belt/Timing Gear Cover

REMOVAL AND INSTALLATION

22R and 22R-E Engines

WARNING: This procedure requires tools which may not be in your tool box. Pulley extractors and a counter-holding bar are required. Do not attempt the procedure without these tools available.

1. Remove the cylinder head.
2. Drain the cooling system and remove the radiator.



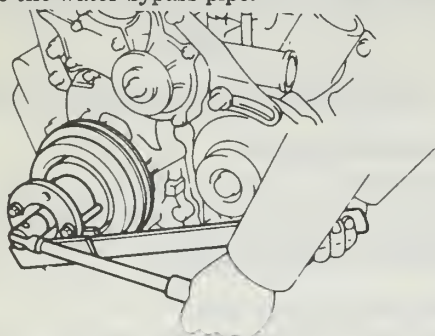
Exploded view of 22R/22R-E timing chain components

3 ENGINE AND ENGINE OVERHAUL

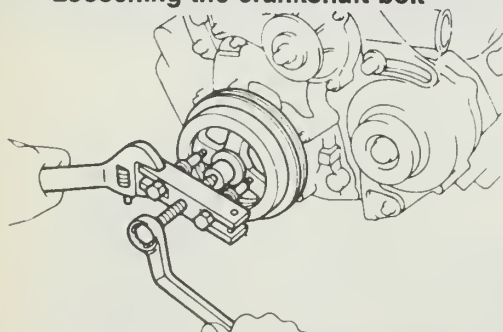
CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

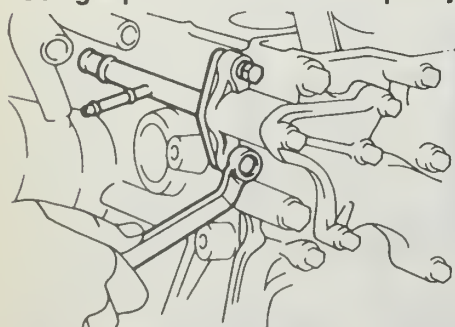
3. On 4WD vehicles, remove the front differential.
4. Remove the oil pan.
5. Remove the power steering belt if so equipped.
6. Remove the air conditioning belt, compressor and bracket if so equipped.
7. Remove the fan clutch (fluid coupling), with the fan and water pump pulley.
8. Remove the crankshaft pulley(s). This bolt will be very tight. Use the counter-holding bar, properly installed, to hold the crankshaft while loosening the bolt. Use the pulley extractor or gear puller to remove the pulley from the shaft.
9. Remove the water bypass pipe.



Loosening the crankshaft bolt



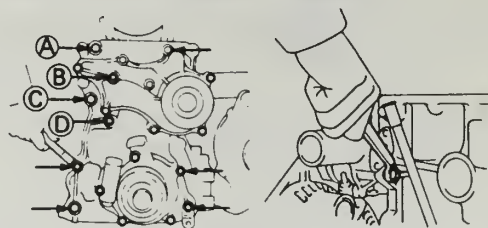
Using a puller to remove the pulley



Remove the No. 1 water bypass pipe

10. Remove the fan belt adjusting bar. If necessary, remove the lower power steering bracket for access.
11. Disconnect the heater water outlet pipe.
12. Remove the bolts holding the timing chain cover assembly. Be careful to loosen only the correct bolts.
13. Remove the chain from the crankshaft damper. Remove the camshaft sprocket and the chain upwards.
14. Remove the oil pump drive splines and the crankshaft sprocket.
15. Remove any gasket material left on the cylinder block.

with A/C. A, B, C, D
with A/C and Air Pump A, B, C



Loosen only the correct bolts to remove the chain cover

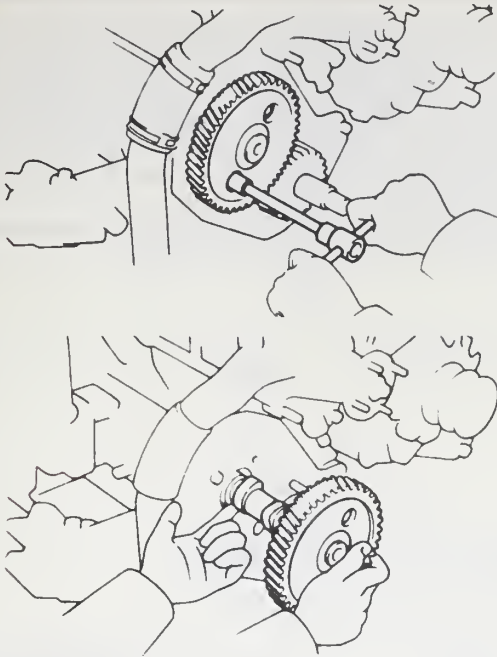


Remove the chain from the damper

16. Turn the crankshaft until the shaft key is on top.
17. Slide the sprocket over the key on the crankshaft. Place the timing chain on the sprocket with the single bright link aligned with the timing mark on the sprocket.
18. Place the timing chain on the cam sprocket so that the link BETWEEN the two bright links is aligned with the timing mark on the sprocket. Make certain the chain is positioned within the dampers (guides).
19. Turn the camshaft sprocket counter-clockwise (viewed from the front) to take slack out of the chain. Rest or support the camshaft sprocket and chain at the top of the block.
20. Install the oil pump drive over the crankshaft key. It may be necessary to use a seal or bearing installing tool.
21. Install new gaskets over the dowels on the timing chain cover. Slide the cover assembly over the dowels and pump spline. Insert the retaining bolts and tighten them. Tighten the 8mm bolts to 9 ft. lbs. (13 Nm) and the 10mm bolts to 29 ft. lbs. (39 Nm).
22. Temporarily install the adjusting bar to the alternator. Install the adjusting bar to the chain cover and tighten the bolts to 9 ft. lbs. (13 Nm).
23. Install the heater water outlet pipe.
24. Install the water bypass pipe.
25. Install the crankshaft pulley and bolt. Use the counter-holding tool to hold the pulley and tighten the bolt to 116 ft. lbs. (157 Nm). If equipped with air conditioning, install the second crankshaft pulley.
26. Install the water pump pulley and fluid coupling with the fan.
27. Adjust the tension on the drive belts.
28. Install the air conditioning compressor bracket, compressor and belt if they were removed.
29. Install the power steering belt and adjust it.
30. Install the oil pan.
31. Install the radiator.
32. Install the front differential.
33. Install the cylinder head.

3F-E Engines

WARNING: This procedure requires tools which may not be in your tool box. Pulley extractors and a counter-holding bar are required. Do not attempt the procedure without these tools available.



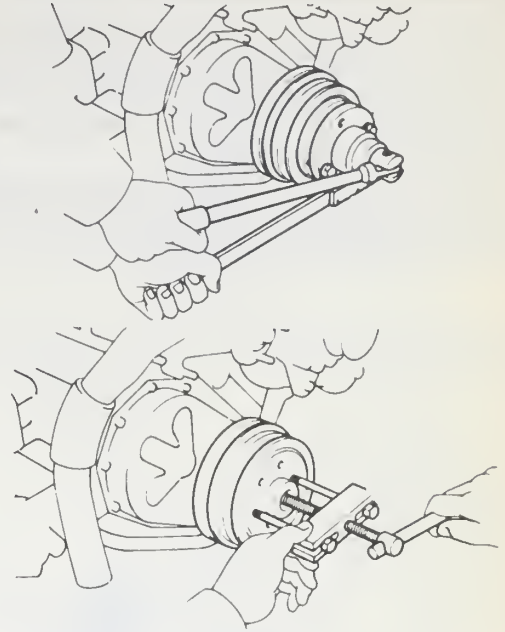
Use great care when removing the camshaft; bearing faces are easily damaged

1. Disconnect the negative battery cable and drain the coolant.

CAUTION

Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

2. Disconnect the accelerator and throttle cables.
3. Remove the air intake hose, air flow meter and air cleaner as an assembly.
4. Loosen the power steering pump drive pulley nut.
5. Remove the fluid coupling with the fan and water pump pulley.
6. Remove the power steering pump and the air conditioning compressor. Remove their brackets.
7. Remove the power steering pump idler pulley and its bracket.
8. Remove the distributor.
9. Remove the cylinder head cover. Remove the rocker shaft assembly.
10. Remove the pushrod cover and then remove the valve lifters. Be certain that they are kept in order.
11. Loosen the six bolts and then slide the power steering pump pulley off the crankshaft.
12. Using the counter-holding tool and a 46mm socket, remove the crankshaft pulley bolt. Remove the pulley with the puller.
13. Remove the oil cooler pipe and its hose.
14. Remove the timing gear cover and gasket. The cover is held by Torx® bolts as well as normal hardware. Remove the timing gear cover and gasket.
15. Set up a dial indicator to measure timing gear backlash. Standard backlash is 0.100–0.183mm (0.0039–0.0072 in.) Maximum allowable backlash is 0.25mm (0.0098 in.). Measurement outside of specifications requires replacement of the timing gears as a set.
16. Align the large (camshaft) gear so the holes allow access to the camshaft retaining bolts. Remove the bolts and very carefully remove the cam with the gear attached. Use great care not to damage the camshaft bearing surfaces on the way out.



Use the correct tools to remove the crankshaft bolt and pulley



Check the timing gear backlash before removal and after installation

17. Use a small punch and hammer to remove the crankshaft pulley set key. Use a small extractor to remove the crank gear.
 18. If necessary, remove the oil nozzle.
 19. Use snap-ring pliers to remove the snap-ring holding the cam gear. Mount the camshaft in a press and, using the proper size tip on the press, press the cam out of the gear.
- To install:**
20. Install the timing gear set key to the camshaft. Assemble the cam, thrust plate and timing gear. Use the press with the proper installation tool, align the timing gear set key with the groove in the gear and press in the camshaft.
 21. Install the snap-ring
 22. Use a thickness gauge to measure the thrust clearance between the thrust plate and camshaft. Correct clearance is 0.200–0.290mm (0.0079–0.0114 in). Maximum allowable is 0.33mm (0.0130 in.).
 23. Put the timing gear on the crankshaft with the timing mark facing forward. Align the timing gear set key with the groove of the timing gear. Use a small mallet to tap the gear into place. Use a plastic mallet to tap in the pulley set key.
 24. Turn the crankshaft timing gear clockwise to place the key groove upward.
 25. Insert the camshaft into the block. Take great care not to damage the camshaft bearing surfaces on the way in.

3 ENGINE AND ENGINE OVERHAUL

26. Align the timing marks of the crankshaft and camshaft. Note that one mark is on a tooth, the other in a valley. The tooth and valley must align exactly. Hint: Cylinder No. 6 should be at TDC compression if everything is set properly.

27. Install the two bolts holding the thrust washer to the block; tighten to 9 ft. lbs. (12 Nm).

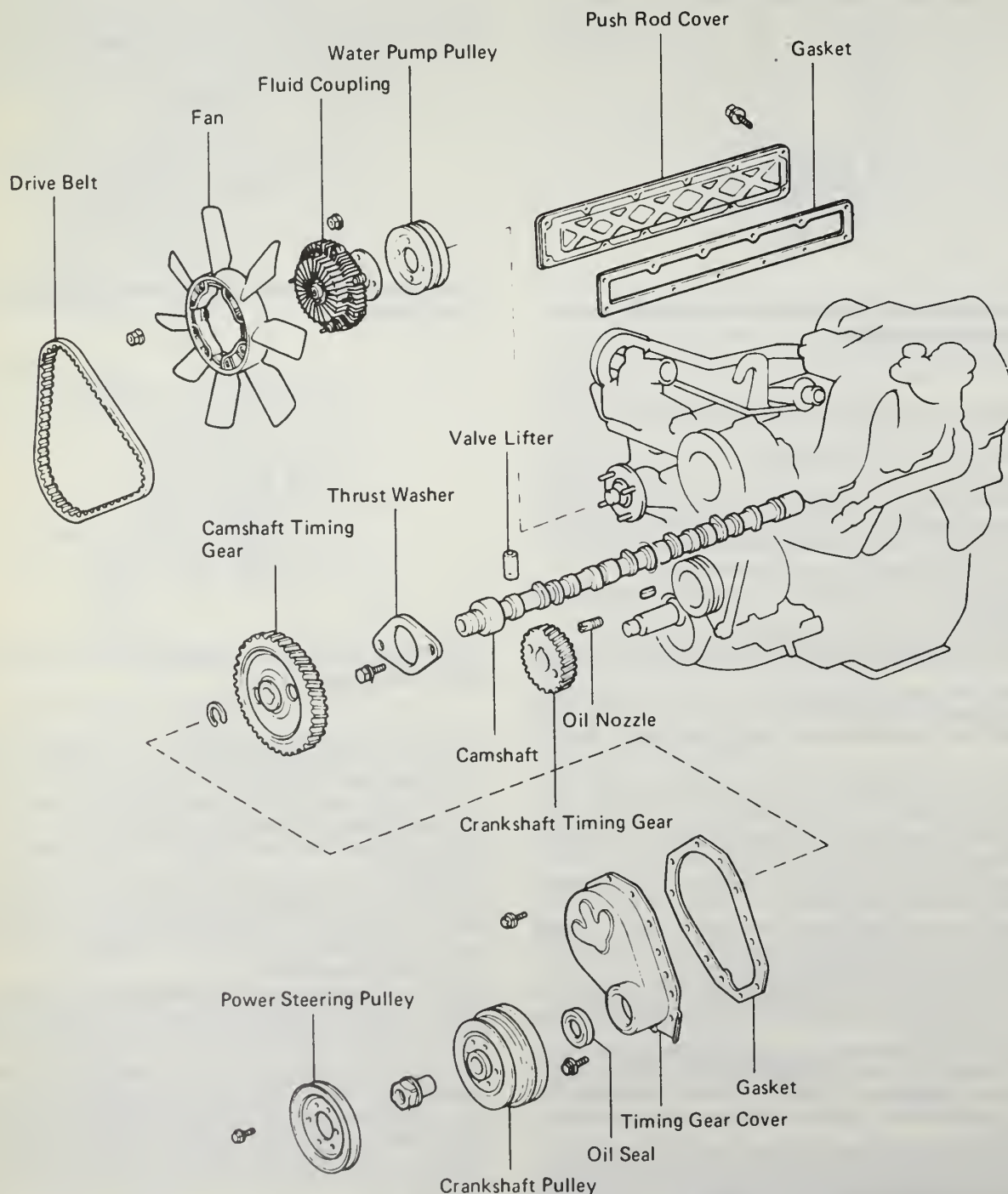
28. Recheck the timing gear backlash.

29. Install the oil nozzle if it was removed. Make certain the oil hole points towards the gear mesh area. Use a hammer and small chisel to stake the threads of the oil nozzle.

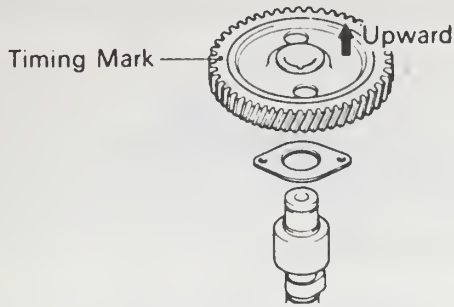
30. There are three sizes of timing gear cover bolts. Apply adhesive to the two A bolts. Install a new gasket and then position the cover. Finger tighten all bolts. Align the crankshaft pulley set key with the groove of the pulley; gently tap the pulley onto the crankshaft. Tighten the cover bolts marked A to 18 ft. lbs. (25 Nm). Tighten those marked B or C to 43 inch lbs. (5 Nm).

31. Tighten the pulley bolt to 253 ft. lbs. (343 Nm). Use of the counter-holding tool is required.

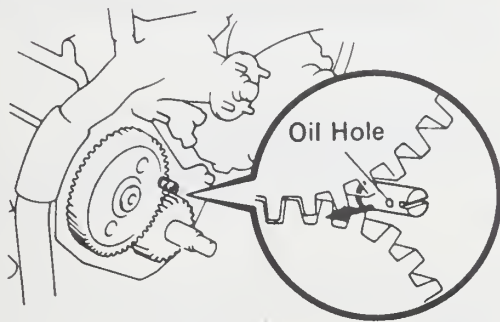
32. Position the power steering pulley on the crankshaft and tighten the six bolts to 13 ft. lbs. (18 Nm).



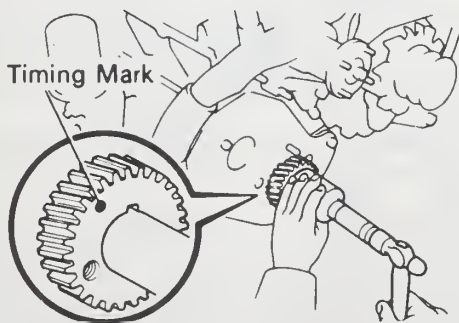
3F-E camshaft, timing gears and related parts



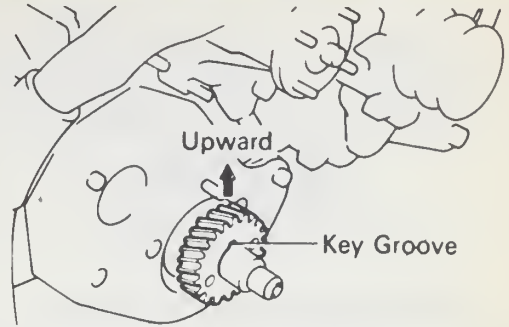
Correct installation of the timing gear requires a press



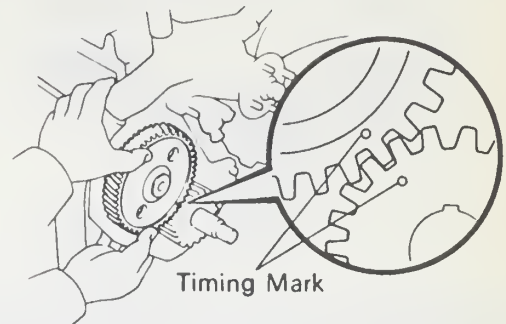
The oil nozzle must be aligned to spray on the gear mesh area



The timing mark must face outward at installation



Align the key groove upward by turning the gear



The timing marks must align exactly when reinstalling the camshaft

Adhesive



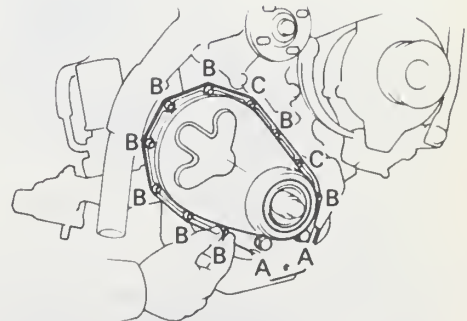
A (14 mm Bolt Head)



B (10 mm Bolt Head)



C (10 mm Bolt Head)



Install the bolts in the correct locations; the large bolts must have sealant on the first few threads

33. Insert the valve lifters into their bores and install the pushrod cover. Tighten the bolts to 35 inch lbs. (4 Nm). Make sure the valve lifters are installed in the same bore from which they came.

34. Install the pushrods, rocker shaft assembly, and the cylinder head cover.

35. Install the distributor.

36. Install the water pump pulley, fluid coupling and fan.

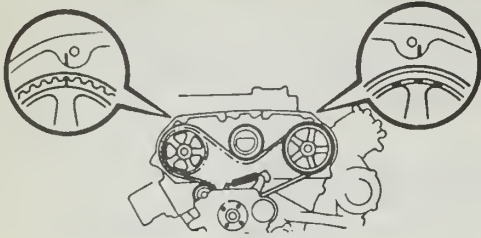
37. Install the power steering pump idler pulley and bracket. Install the power steering pump and air conditioning compressor. Adjust the drive belts.

38. Install the air cleaner assembly; connect and adjust the accelerator and throttle cables.

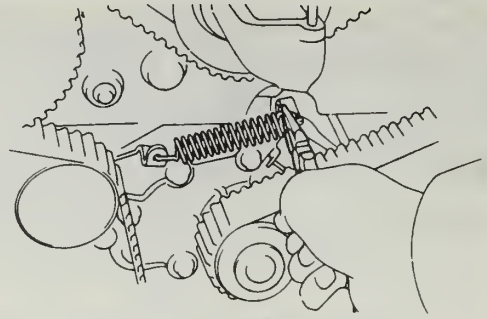
39. Fill the engine with coolant and connect the battery cable.

40. Start the engine and check for leaks. Check the ignition timing.

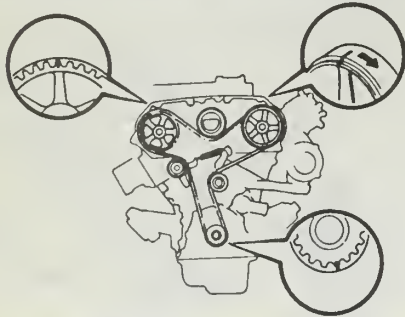
3 ENGINE AND ENGINE OVERHAUL



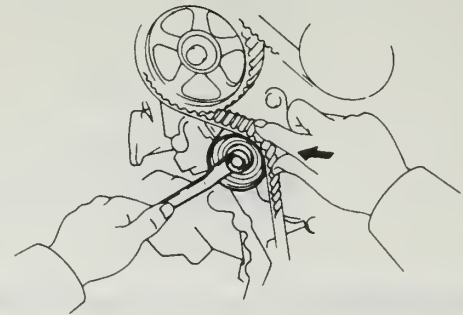
Align each camshaft timing mark



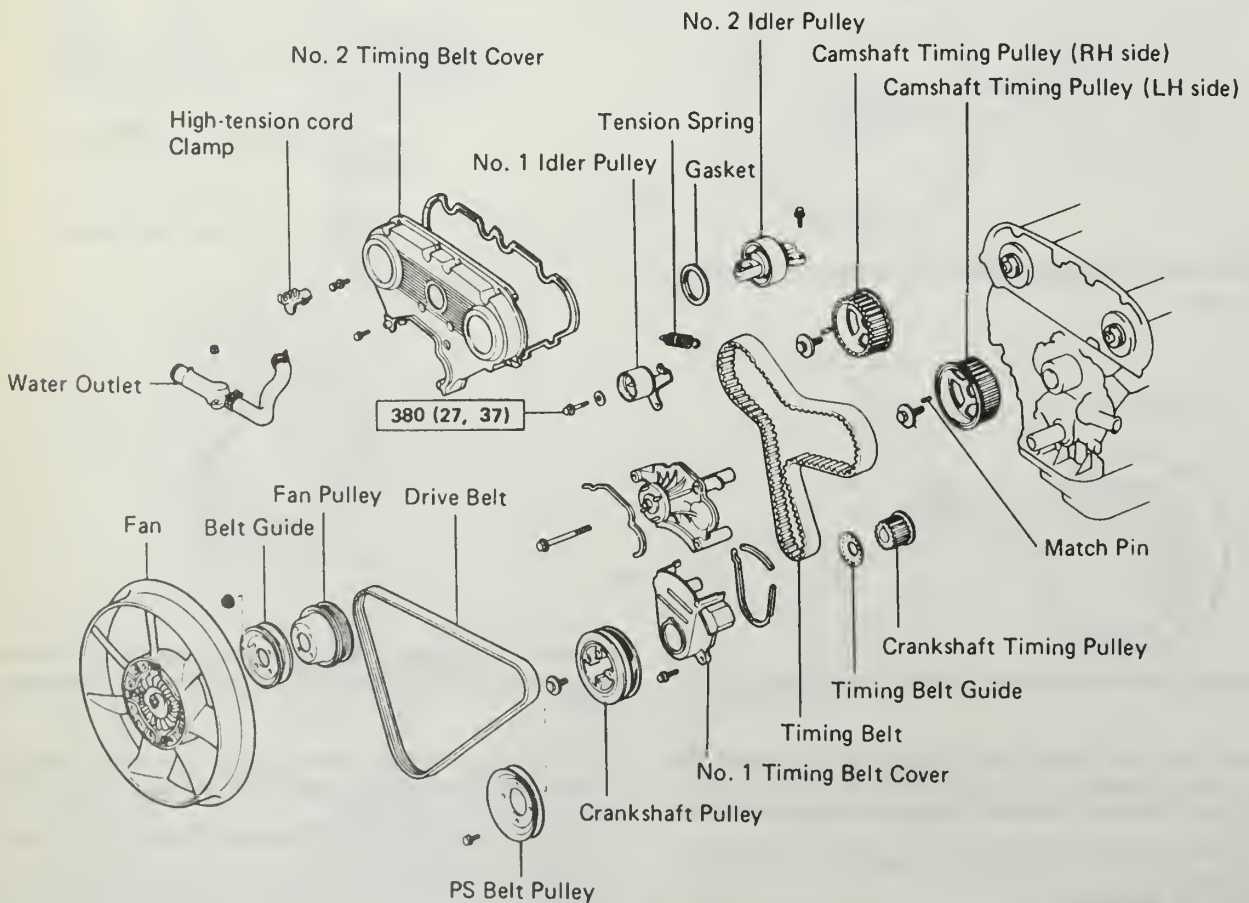
Remove the tension spring



Make chalk marks if the belt is to be reused



Move the tensioner all the way to the left



3VZ-E timing belt and related components

41. Shut the engine off. Remove the valve cover and adjust the valves.
42. Road test the vehicle. Recheck engine coolant level.

3VZ-E Engines

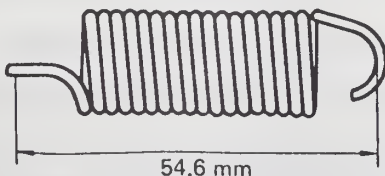
WARNING: This procedure requires tools which may not be in your tool box. Pulley extractors and a counter-holding bar are required. Do not attempt the procedure without these tools available.

1. Disconnect the negative battery cable and drain the coolant.

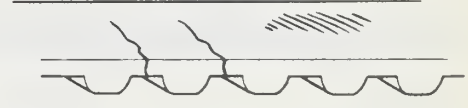
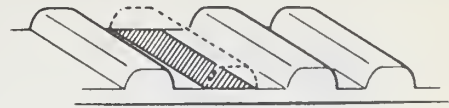
CAUTION

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2. Remove the radiator and shroud.
 3. Remove the power steering belt and pump.
 4. Remove the spark plugs.
 5. Disconnect the Nos. 2 and 3 air hoses at the air pipe.
 6. Disconnect the No. 1 water by-pass hose at the air pipe and then remove the water outlet.
 7. Remove the air conditioning belt. Remove the alternator drive belt, fluid coupling, guide and fan pulley.
 8. Disconnect the high tension cords and their clamps at the No. 2 (upper) timing belt cover and then remove the cover and its three gaskets.
 9. Rotate the crankshaft pulley until the groove on its lip is aligned with the 0 on the No. 1 (lower) timing belt cover. This should set the No. 1 cylinder at TDC of its compression stroke. The matchmarks on the camshaft timing pulleys must be in alignment with those on the No. 3 (upper rear) timing cover. If not, rotate the engine 360° (one complete revolution).
 10. Remove the power steering pulley. Use the counter-holding tool to aid in removal of the crank pulley bolt. Remove the crankshaft pulley using a puller.
 11. Remove the fan pulley bracket and then remove the No. 1 timing belt cover.
 12. If the belt is to be reused after removal, mark an arrow on the belt showing the direction of rotation. Make matchmarks on the side of the belt and the flanges of each pulley. These marks will be important at reassembly.
 13. Remove the timing belt guide and remove the tension spring.
 14. Loosen the idler pulley bolt and shift the idler to the left as far as it will go. Temporarily tighten the bolt and release tension from the belt. Slide the belt off the pulleys.
 15. Protect the belt at all times. Do not bend, twist or turn the belt inside out. Do not allow the belt to contact oil, grease or water.
 16. Examine the belt closely for cracking, loose teeth, separation or wear on the edges. If the belt is not virtually perfect, replace it.
 17. Check the idler pulleys for smoothness of rotation. Inspect the tension spring; correct length is 2.15 in (54.6mm).
- To install:**
18. Make absolutely certain the marks on the camshaft pulleys are aligned with the marks on the rear belt cover. Check the lower belt pulley; align its mark with the mark on the oil pump housing.

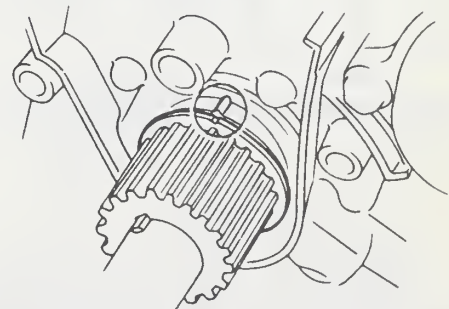


Measure the tension spring



Inspect the belt closely for any fault

19. Install the timing belt onto the cam pulleys, idler pulley, water pump pulley and crank pulley. If reusing the original belt, take great care to align all the marks made before removal.
20. Loosen the idler pulley bolt; move it as far to the right as it will go. Temporarily tighten it in position.
21. Install the tension spring. Loosen the idler pulley bolt to the point that the idler pulley moves with the tension of the spring.
22. Temporarily install the crankshaft pulley bolt. Turn the crankshaft clockwise two complete revolutions from TDC to TDC. Check that the mark on each pulley aligns exactly with the matching marks on the covers or housing.
23. Tighten the idler pulley bolt to 27 ft. lbs. (37 Nm).
24. Remove the crank pulley bolt. Install the belt guide on the crankshaft pulley. The cupped side faces outward.
25. Install the No. 1 (bottom) belt cover with the two gaskets. Tighten the bolts to (5.4 Nm).

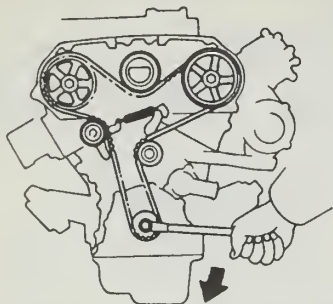


Before installation, set the lower belt pulley to the mark on the oil pump housing

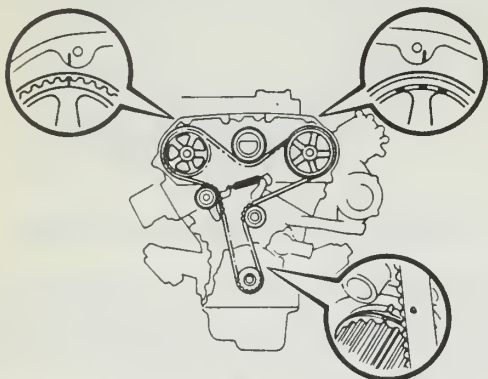


Double check the cam pulley alignment

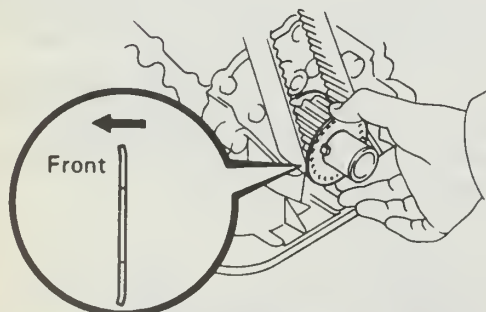
3 ENGINE AND ENGINE OVERHAUL



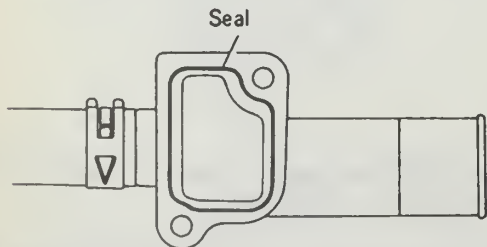
Turn the crank two full rotations clockwise



After rotating the engine, ALL the timing marks must align perfectly



Install the belt guide, cupped side out



Put sealant on the water outlet before Installation

26. Install the fan pulley bracket and tighten it to 30 ft. lbs. (41 Nm).

27. Install the No. 2 cover and tighten the bolts 48 inch lbs. (5.4 Nm).

28. Position the crankshaft pulley so the groove in the pulley is aligned with the woodruff key in the crankshaft. Tighten the bolt to 181 ft. lbs. (245 Nm).

27. Install the fan pulley, guide, fluid coupling and alternator drive belt. Adjust the belt tension.

28. Install the power steering pump and belt. Install the air conditioning belt. Adjust the belt tension.

29. Apply sealant to the contact surface of the water outlet. Install the water outlet and connect the by-pass hose. Connect the Nos. 2 and 3 air hoses.

30. Install the spark plugs.

31. Install the radiator and fill with coolant.

32. Road test the vehicle. Check for leaks. Recheck the ignition timing.

Camshaft Sprockets or Pulleys

REMOVAL AND INSTALLATION

22R and 22R-E

The cam sprocket is removed from the camshaft as part of the rocker assembly removal. If the sprocket is to be removed from the chain, support the chain with a piece of wood, keeping the chain engaged to the lower sprocket. If the chain comes off the bottom sprocket, the timing chain covers must be removed and the chain correctly installed. Refer to Timing Chain Removal and Installation in this Section.

3F-E

Removal of the camshaft timing gear is described in the Timing Gear Removal and Installation part of this section. The gear cannot be removed without removing the camshaft. A press must be used to separate the gear from the camshaft.

3VZ-E

1. Remove the timing belt.

2. Use a properly installed counter-holding tool, remove the pulley bolt, the pulley and the match pin. Note that the left and right pulleys are different; label them to avoid confusion at reassembly.

WARNING: Do not attempt to use the timing belt to hold tension on the pulley while loosening or tightening the retaining bolt.

To install:

3. Align the camshaft match pin hole with the marks on the upper rear timing belt cover. This puts the pin holes straight up.

4. Install the timing pulleys, observing correct placement of the left and right pulleys. Install the bolts, but do not install the match pin. Check that the bolt head is not touching the pulley (It's not completely tight yet). Align the timing mark on each pulley with the marks on the No. 3 timing cover.

5. Install the timing belt, following the procedures given in this section. After the engine has been rotated two full revolutions and the timing marks checked, tighten the idler pulley bolt.

6. Remove the camshaft timing pulley bolts. Align the pulley match pin hole with the hole in the camshaft; install the match pin. Reinstall the camshaft pulley bolts.

7. Using a properly installed counter-holding tool, torque the pulley bolts to 80 ft. lbs. (108 Nm). Take great care not to nick or damage the timing belt.

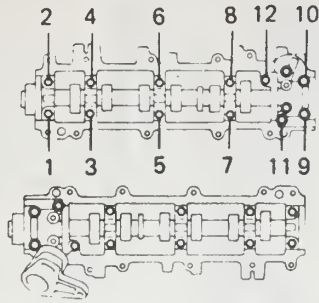
8. Continue with the re-installation of the timing belt.

Camshaft And Bearings

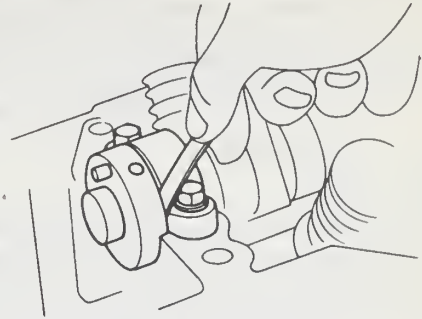
REMOVAL AND INSTALLATION

3F-E Engines

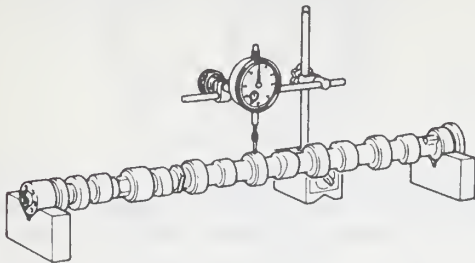
To service the camshaft on these engines, please refer to the Timing Gear Removal and Installation procedure.



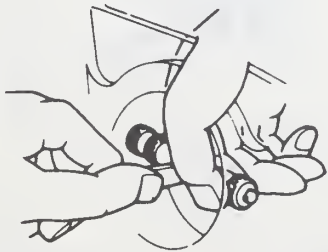
tighten the 3VZ-E camshaft bearing cap bolts in the correct order



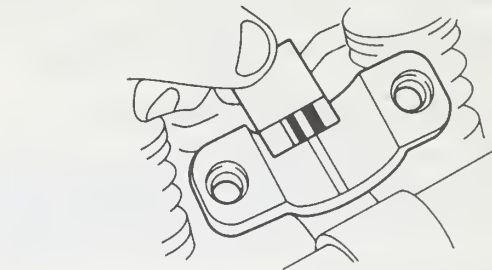
Measuring the camshaft end play



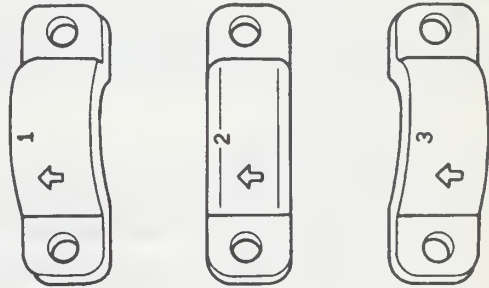
Camshaft run-out (eccentricity) must be measured with a dial indicator



Use an inside micrometer to measure camshaft housing bore diameter



Use Plastigage® to measure bearing clearance



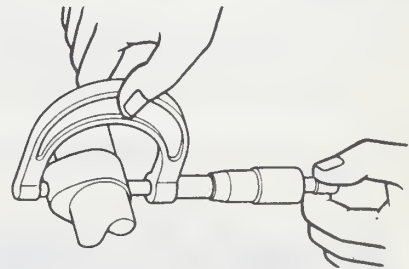
Mark the bearing caps if not already marked

22R, 22R-E and 3VZ-E

1. Perform the Cylinder Head Removal procedure (for your engine) far enough to gain access to the camshaft bearing cap bolts. If you are going to remove the head anyway, remove the cam after removing the cylinder head.
2. Prior to removing the camshaft, measure its end-play with a feeler gauge. Consult the Camshaft Specifications Chart for the correct end-play. If the end-play is beyond this, replace the head.
3. Remove the bearing cap bolts. Remove the caps. Keep them in order, or mark them.
4. Measure the bearing oil clearance by placing a piece of Plastigage® on each journal. Replace the caps and tighten their bolts to 13-16 ft. lbs. (18-22 Nm).
5. Remove the caps and measure each piece of Plastigage®. If the clearance is greater than 0.1mm, replace the head and cam.
6. Lift the camshaft out of the head.

To install:

7. Coat all of the camshaft bearing journals with engine oil.
8. Lay the camshaft in the head.
9. Install the bearing caps in numerical order with their arrows pointing forward (toward the front of the engine) on 4 cylinder engines. On the 3VZ-E, the right bank arrows point forward with No. 1 cap at the front of the engine. The left bank arrows point to the rear with the No. 1 cap at the rear.



Measure lobe height (shown) and journal diameter with a micrometer

10. Install the cap bolts and tighten them in three passes and in the correct order, to 13-16 ft. lbs.
11. Complete the cylinder head installation procedure and/or valve rocker installation.

CAMSHAFT INSPECTION

A dial indicator, micrometer and inside micrometer are all needed to properly measure the camshaft and camshaft housing. If these instruments are available, proceed; if they are not available, have the parts checked at a reputable machine shop. Camshaft specifications are included in a chart in this Section.

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1. Using the micrometer, measure the height of each cam lobe. If a lobe height is less than the minimum specified, the lobe is worn and the cam must be replaced.

2. Place the cam in V-blocks and measure its run-out at the center journal with a dial indicator. Replace the cam if run-out exceeds:

- 0.20mm — 22R and 22R-E
- 0.06mm — 3VZ-E
- 0.30mm — 3F-E

3. Using the micrometer, measure journal diameter, jot down the readings and compare the readings with those listed in the Camshaft Specifications Chart. Measure the housing bore inside diameter with the inside micrometer, and jot the measurements down. Subtract the journal diameter measurement from the housing bore measurement. If the clearance is greater than the maximum listed under Bearing Clearance in the chart, replace the camshaft and/or the housing.

Pistons and Connecting Rods

REMOVAL AND INSTALLATION

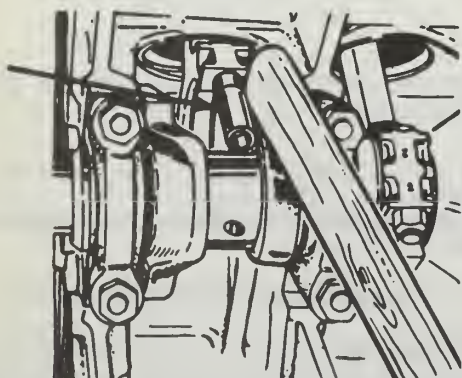
NOTE: This procedure requires removal of most of the engine parts, including the head and pan. While it can be performed in the vehicle, removing the engine from the vehicle makes the job much easier. Mount the engine on an engine stand so that it may be rotated or moved about the work area.

All Engines

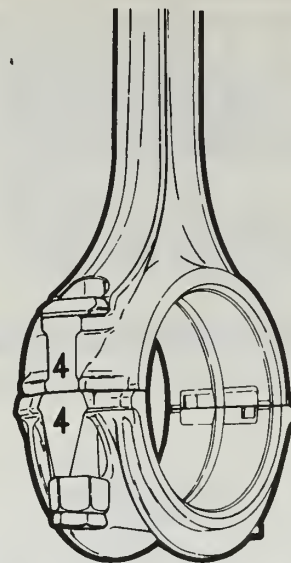
NOTE: Before removing the piston assemblies, connecting rod bearing clearance and side clearance should be checked. Refer to the Connecting Rod Inspection procedure in this chapter.

1. Remove the cylinder head.
2. Remove the oil pan and pump.
3. Position a cylinder ridge reamer into the top of the cylinder bore. Keeping the tool square, ream the ridges from the top of the bore. Clean out the ridge material with a solvent-soaked rag, or blow it out with compressed air.
4. Remove the oil strainer. Use a numbered die set to mark each cap and connecting rod with its cylinder number. Unbolt the connecting rod caps.
5. Place pieces of rubber hose over the rod bolts, to protect the cylinder walls and crank journals from scratches. Push the connecting rod and piston up and out of the cylinder from the bottom. Use a wooden hammer handle to push on the bottom of the piston top.

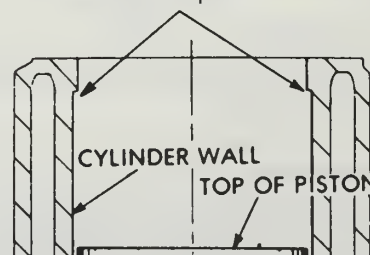
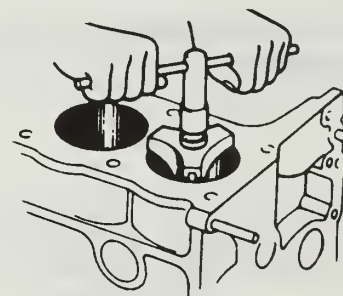
WARNING: Use care not to scratch the crank journals or the cylinder walls.



Cover the rod bolts with rubber tubing (arrow) before removing the piston and rod assemblies



Numbering the rod and cap is the best method of identification. Failing that, an angled mark can be made. The marks must align exactly at installation



The stroke of the piston creates a recessed ridge at the top of each cylinder. Remove it with a ridge reamer

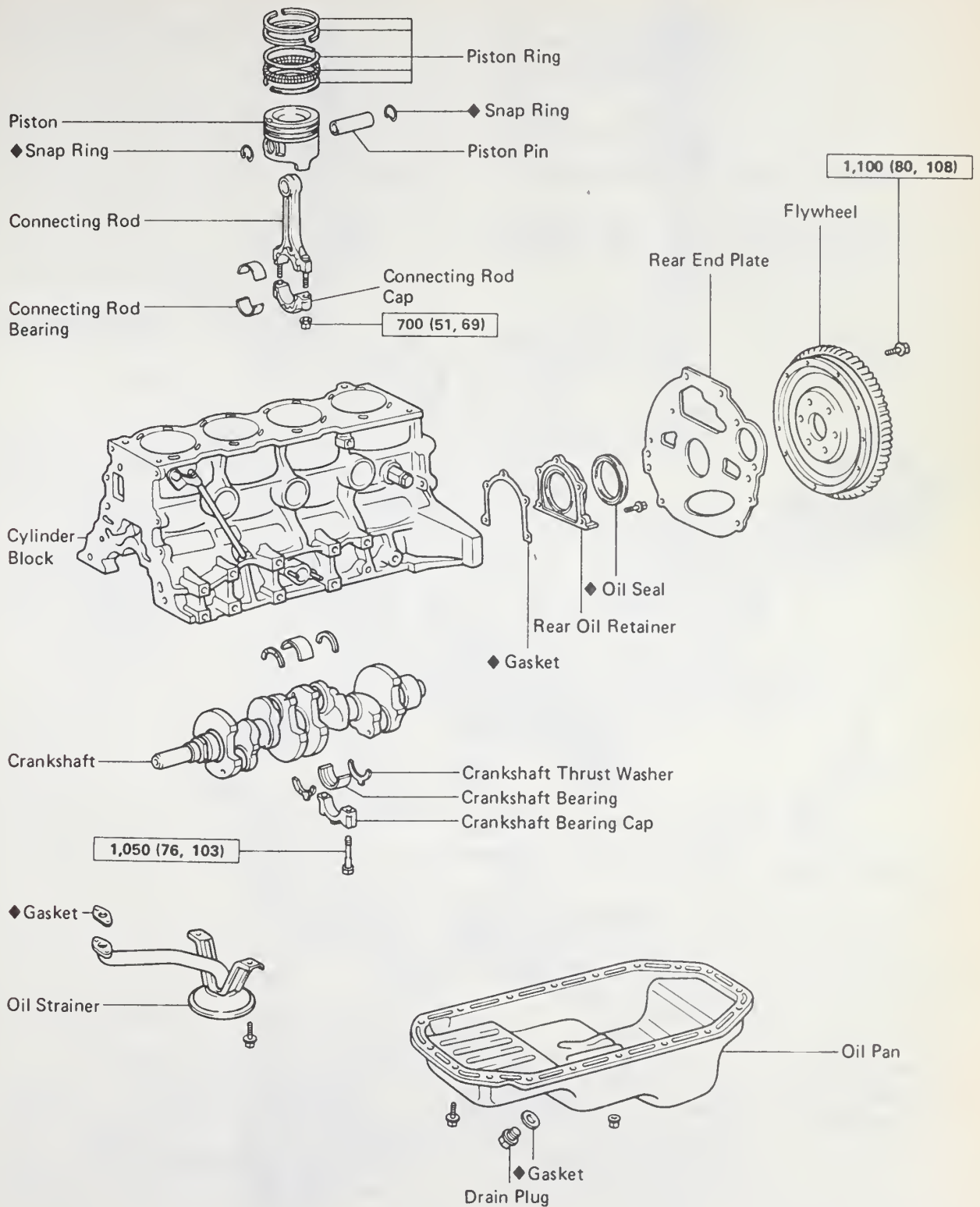
6. Keep the piston and bearing cap together.
- To install:**

7. Apply a light coating of engine oil to the pistons, rings, and outer ends of the wrist pins (piston pins).

8. Examine the piston to insure that it has been assembled with its parts positioned correctly. Be sure that the ring gaps are not pointed toward the thrust face of the piston and that they do not overlap.

9. Place pieces of rubber hose over the connecting rod bolts, to keep the threads from damaging the crank journal and cylinder bore. Install the pistons, using a ring compressor, into the cylinder bore. Be sure that the appropriate marks on the piston are facing the front of the cylinder.

NOTE: It is important that the pistons, rods, bearing, etc., be returned to the same cylinder bore from which they were removed.

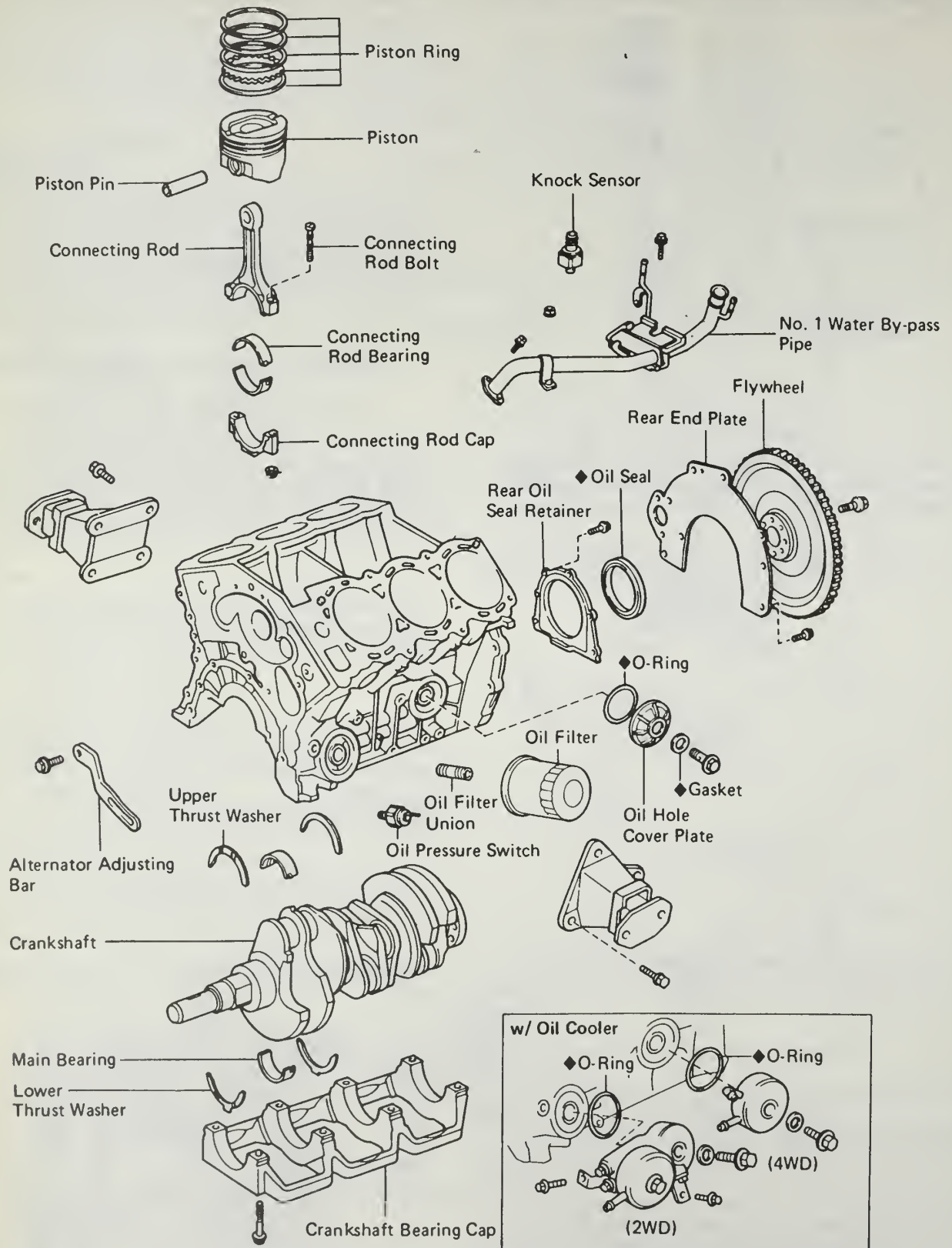


kg-cm (ft-lb, N-m)

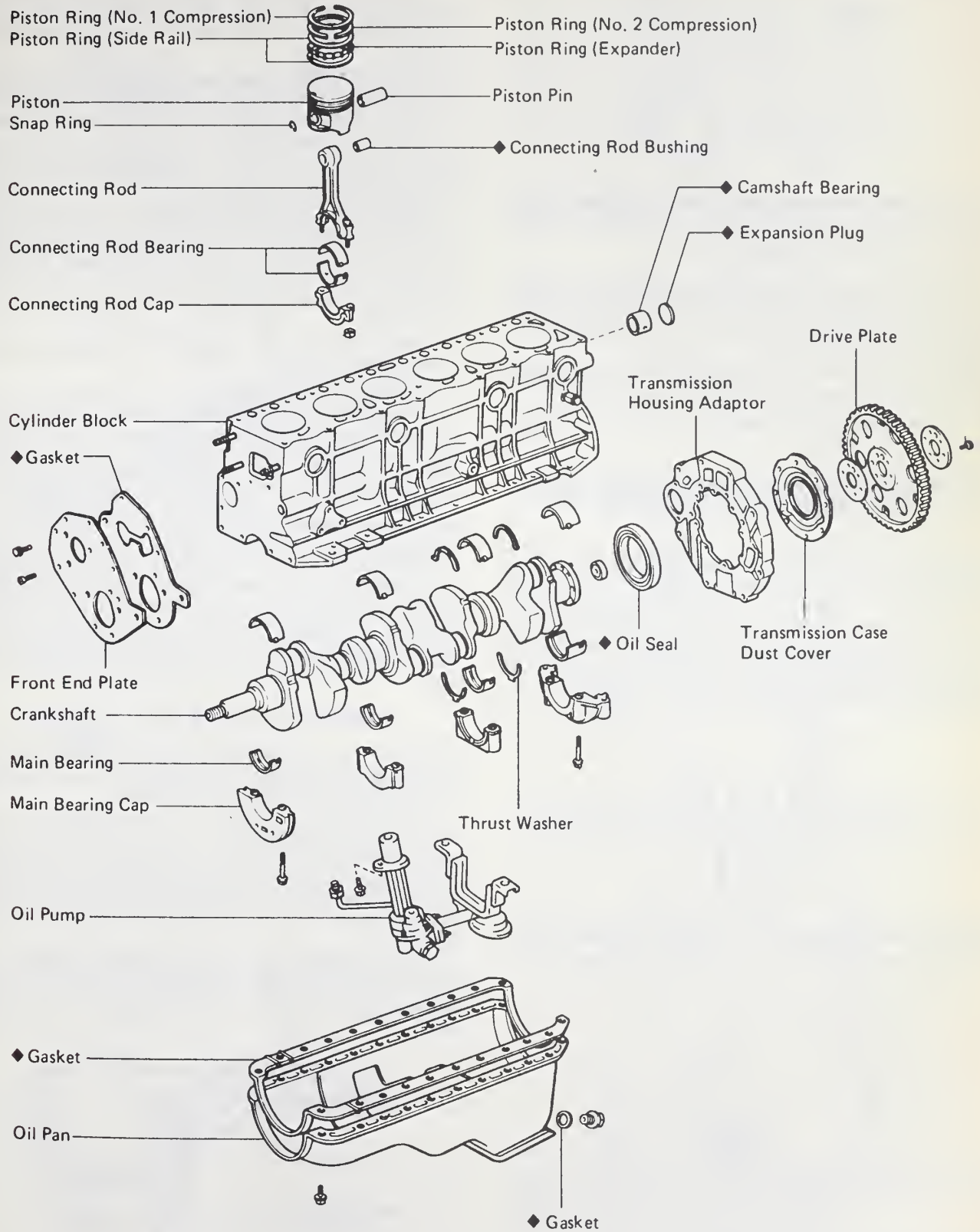
◆ Non-reusable part

Engine block and components – 22R and 22R-E

3 ENGINE AND ENGINE OVERHAUL

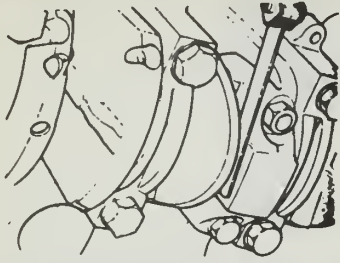


Engine block and components – 3VZ-E



Engine block and components —

3 ENGINE AND ENGINE OVERHAUL



Checking the connecting rod side clearance. Make sure the feeler gauge is between the shoulder of the crank journal and the side of the rod

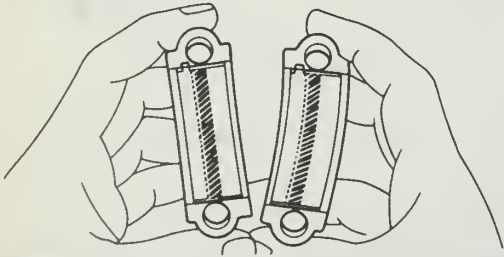
10. Remove the protective rubber hoses. Make certain the connecting rod and cap have the bearings correctly installed. Fit the cap to the rod bolts; tighten them to the torque figures given in the Torque Specifications chart.

NOTE: Be sure that the mating marks on the connecting rods and rod bearing caps are aligned.

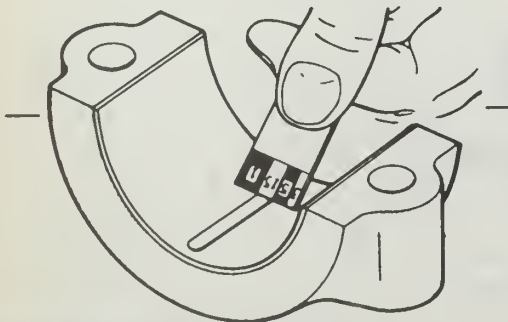
12. The rest of the removal procedure is performed in the reverse order of installation.

CONNECTING ROD INSPECTION AND BEARING REPLACEMENT

Connecting rod side clearance and crankshaft bearing inspection/replacement should be performed while the rods are still installed in the engine. Determine the clearance between the connecting rod sides and the crankshaft using a feeler gauge. If clearance is below the minimum, check with a machinist about machining the rod to provide adequate clearance or replace the rod. If clearance is excessive, substitute an unworn rod and recheck; if clearance is still outside specifications, the crankshaft must be welded and reground, or replaced.



Inspect the rod bearings for scuffing and other wear. Check the crank journal for the same conditions



Use the scale on the Plastigage® envelope to determine the clearance after the plastic has been crushed by the cap

To check connecting rod bearing clearances, remove the rod bearing caps one at a time. Using a clean, dry shop rag, thoroughly clean all oil from the crank journal and bearing insert in the cap.

NOTE: The Plastigage® gaging material you will be using to check clearances is soluble in oil; any oil on the journal or bearing could result in an incorrect reading.

Place a strip of Plastigage® along the full length of the bearing insert (along the crank journal if the engine is out of the truck and inverted). Reinstall the cap and torque to specifications listed in the Torque Specifications chart.

Remove the rod cap and determine the bearing clearance by comparing the width of the now flattened Plastigage® to the scale on the Plastigage® envelope. Journal taper is determined by comparing the width of the Plastigage® strip near its ends. Rotate the crankshaft 90° and retest, to determine journal eccentricity.

NOTE: Do not rotate the crankshaft with the Plastigage® installed.

If the bearing insert and crank journal appear intact and are within tolerances, no further service is required and the bearing caps can be reinstalled (remove Plastigage® before installation). If clearances are not within tolerances, the bearing inserts in both the connecting rod and rod cap must be replaced with undersize inserts, and/or the crankshaft must be reground.

To install the bearing insert halves, press them into the bearing caps and connecting rods. Make sure the tab in each insert fits into the notch in each rod and cap. Lube the face of each insert with engine oil prior to installing each rod into the engine.

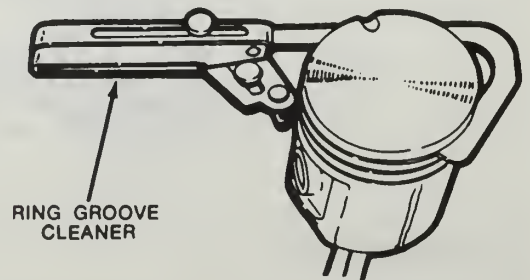
The connecting rods can be further inspected when they are removed from the engine and separated from their pistons. Rod alignment (straightness and squareness) must be checked by a machinist, as the rod must be set in a special fixture. Many machine shops also perform a crack checking service, a process that shows up any tiny cracks in the metal.

PISTON RING REPLACEMENT

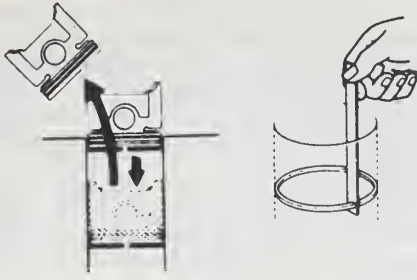
NOTE: The cylinder walls must be de-glazed (honed) when the piston rings are replaced. De-glazing insures proper ring seating and oil retention.

Using a piston ring expander, remove the rings one by one. Always remove and replace the rings of each piston before going on to the next. This helps avoid mixing up the rings. When the rings have been removed from each piston, perform the end gap and piston inspection and cleaning procedure below. The rings are marked on one side, the mark denoting the up side for installation.

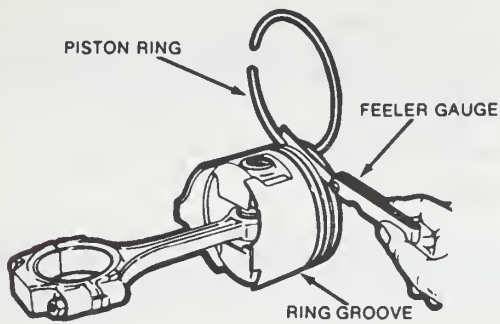
Install the rings using the ring expander, starting with the top compression ring and working down. Make sure the marks (T or N) are facing up on each ring. Position the rings so that the ring and gaps are set as in the illustrations. Never align the end gaps!



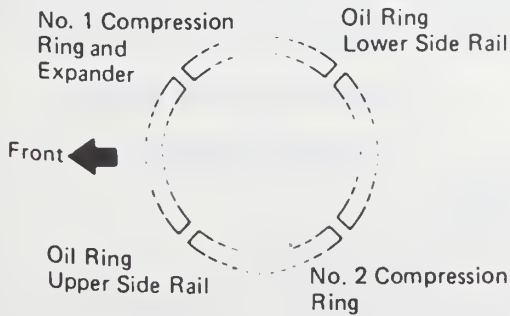
Use a ring groove cleaner or a piece of an old ring to clean the grooves



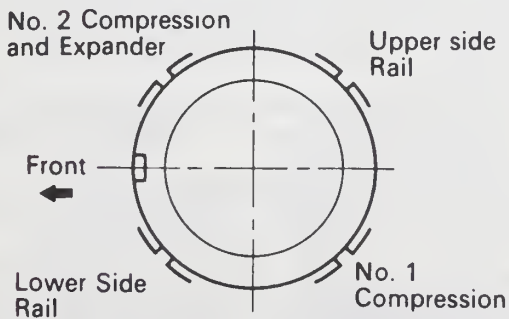
Use a piston to push a new ring into the cylinder bore. Use a feeler gauge to measure end gap



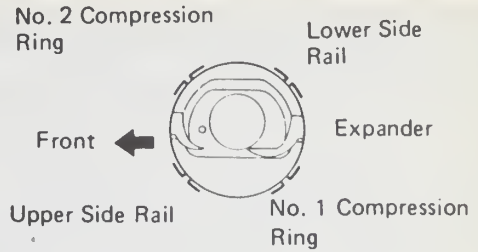
Check the side clearance between the ring and piston



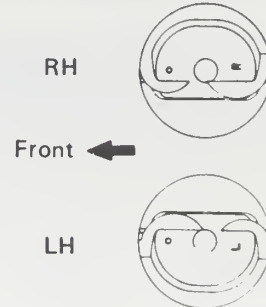
Piston and ring positioning – 22R and 22R-E



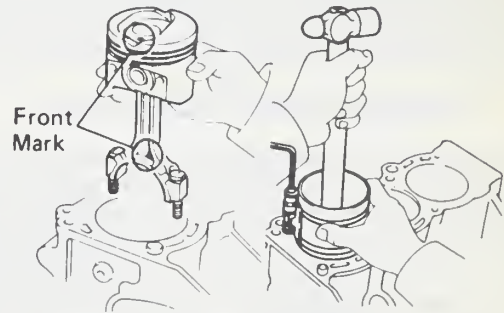
Piston and ring positioning – 3F-E



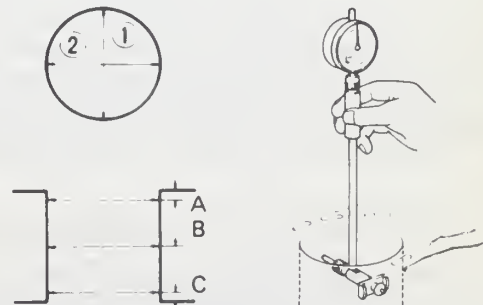
Piston and ring positioning – 3VZ-E



Piston positioning for left and right banks – 3VZ-E



Installing the piston. Don't try it without the ring compressor; the penalty is a broken ring



Use a dial gauge to measure each cylinder bore at the top, middle and bottom. Take these measurements in two dimensions

3 ENGINE AND ENGINE OVERHAUL

The pistons are marked with a notch in the piston head. When installed in the engine, the notch markings must be facing towards the front of the engine.

The connecting rods should be installed in the engine with the forged marks on the bearing caps and on the bottom of the rod facing toward the front of the engine. It is advisable to number the pistons, connecting rods and bearing caps in some manner so that they can be reinstalled in the same cylinder, facing the same direction, from which they were removed.

The piston rings must be installed with their gaps NOT aligned, nor with ANY gap facing the front of the cylinder.

CLEANING AND INSPECTION

Clean the piston after removing the rings, by first scraping any carbon from the piston top. Do not scratch the piston in any way during cleaning. Use a broken piston ring or ring cleaning tool to clean out the ring grooves. Clean the entire piston with solvent and a stiff bristle brush (NOT a wire brush).

Once the piston is thoroughly cleaned, insert the side of a good piston ring (both No. 1 and No. 2 compression on each piston) into its respective groove. Using a feeler gauge, measure the clearance between the ring and its groove. If clearance is greater than the maximum listed under Ring Side Clearance in the Piston and Ring chart, replace the ring(s) and if necessary, the piston.

To check ring end-gap, insert a compression ring into the cylinder. Lightly oil the cylinder bore and push the ring down into the cylinder with a piston, to the bottom of its travel. Measure the ring end-gap with a feeler gauge. If the gap is not within specification, replace the ring; DO NOT file the ring ends.

CYLINDER BORE INSPECTION

Place a rag over the crankshaft journals (the part the rods connect to). Wipe out each cylinder with a clean, solvent-soaked rag. Visually inspect the cylinder bores for roughness, scoring or scuffing; also check the bores by feel. Measure the cylinder bore diameter with an inside micrometer, or a telescope gauge and micrometer. Measure the bore at points parallel and perpendicular to the engine centerline at the top (below the ridge) and bottom of the bore. Subtract the bottom measurements from the top to determine cylinder taper.

Measure the piston diameter with a micrometer; since this particular micrometer may not be part of your tool kit you may wish to have the pistons measured at a machine shop. Take the measurements at right angles to the wrist pin center line, about 1 in. (25mm) down the piston skirt from the top. Compare this measurement to the bore diameter of each cylinder. The difference is the piston clearance. If the clearance is greater than that specified in the Piston and Ring Specifications chart, have the cylinders honed or rebored and replace the pistons with an over-size set. Piston clearance can also be checked by inverting a piston into a oiled cylinder, and sliding in a feeler gauge between the two.

WRIST PIN REMOVAL AND INSTALLATION

Wrist pin and/or connecting rod (small-end) bushing wear can be checked by rocking the piston at right angles to the wrist pin by hand. If more than very slight movement is felt, the pin and/or rod bushing must be replaced.

Except for the 3VZ-E engine, the pistons for the engines covered here must be heated in hot water to expand them before the wrist pins can be removed and installed. The four cylinder pistons must be heated to 176°F (80°C). This job can be performed at a machine shop if the idea of boiling pistons in the kitchen doesn't appeal to you. If you decide to do it, however, remember that each piston, pin and connecting rod assembly is a matched set and must be kept together until reassembly.

CAUTION

The components will be in water very close to the boiling point. Wear heavy waterproof gloves or have plenty of padding material available to protect your hands from burns or scalding.

1. Using needle nose or snapping pliers, remove the snaprings from the piston.
2. Heat the piston(s) in hot water to the correct temperature.
3. Using a plastic-faced hammer and driver, lightly tap the wrist pin out of the piston. At this temperature, the pin may come out under finger pressure. Remove the piston from the connecting rod.
4. Assembly is in the opposite order of disassembly. Place the a new snap ring on one side of the piston; make certain the piston and rod are aligned with the front marks facing the same way.
5. The piston must again be heated to install the wrist pin and rod. The temperature of the water is important; if the pin can be pushed in at a lower temperature, replace the pin and piston. The pin it should be able to be pushed into place with your thumb when heated.
6. Install the other snap ring to hold the pin.

3VZ-E Engine

The piston pins can be removed or installed with a press, but special precautions must be observed. The tip of the press must be the diameter of the pin so that force is applied evenly. The piston must be supported on a broad surface with an opening below the pin hole. Force must be exerted precisely straight on to the pin; any cocking of the piston may result in cracking the piston.

Although this process can be accomplished if the correct tools are at hand, it is still recommended to have the pins pressed by either a dealer or machine shop; the slight cost outweighs the risk (and cost) of replacing an otherwise good piston.

Rear Main Oil Seal

REPLACEMENT

All Engines

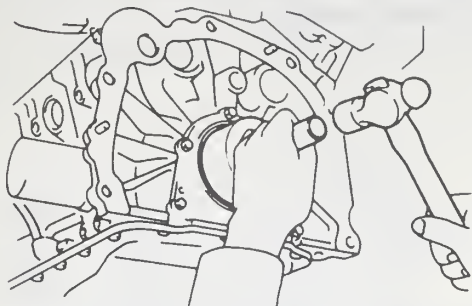
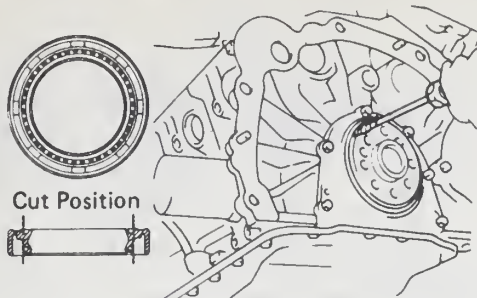
SEAL RETAINER ON ENGINE

1. Remove the transmission.
2. Remove the clutch cover assembly and flywheel (manual trans.) or the flexplate (auto. trans.).
3. Use a small, sharp knife to cut off the lip of the oil seal. Take great care not to score any metal with the knife.
4. Use a small pry bar to pry the old seal from the retaining plate. Be careful not to damage the plate. Protect the tip of the tool with tape and pad the fulcrum point with cloth.
5. Inspect the crankshaft and seal lip contact surfaces for any sign of damage.
6. Apply a light coat of multi-purpose grease to the lip of a new oil seal. Loosely fit the seal into place by hand, making sure it is not crooked.
7. Use a seal driver of the correct size to install the seal. Tap it into place until the surface of the seal is flush with the edge of the housing.

NOTE: Use the correct tools. Homemade substitutes may install the seal crooked, resulting in oil leaks and premature seal failure.

SEAL RETAINER REMOVED

For all but the 3F-E engine, the rear seal retainer may be unbolted and removed from the engine. This is usually done when the engine is out of the vehicle during a major repair. (The 3F-E uses the 2-piece crankshaft rear main bearing cap to hold the seal and is only disassembled during crank removal.)



Removing and installing the rear main seal with the retainer in place. 3VZ-E shown, all others use similar procedure

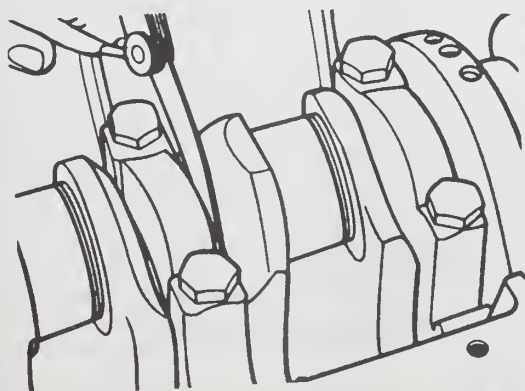
If the retainer is removed, support the retainer on two thin pieces of wood and proceed with Steps 4-7 of the on-engine procedure. Use great care not to damage or crack the housing.

Crankshaft and Main Bearings

REMOVAL AND INSTALLATION

NOTE: Before removing the crankshaft, check main bearing clearances as described in Main Bearing Clearance Check. This check should always be performed before and after any repairs to the crank or bearings.

1. Remove the piston and connecting rod assemblies.
2. Check crankshaft thrust clearance (end play) before removing the crank from the block. Using a small pry bar, gently force the crankshaft the extent of its travel forward, and measure thrust clearance at the center main bearing (No. 4 bearing on 6-cylinder engines, No. 3 on 4-cylinder engines) with a feeler gauge. Pry the crankshaft the extent of its rearward travel, and measure the other side of the bearing. If clearance is greater than that specified, the thrust washers must be replaced..



Check the crankshaft end-play before removal

3. Using a punch, mark the corresponding main bearing caps and saddles according to position: one punch (dot) on the front main cap and saddle, two on the second, three on the third, etc. This ensures correct reassembly.

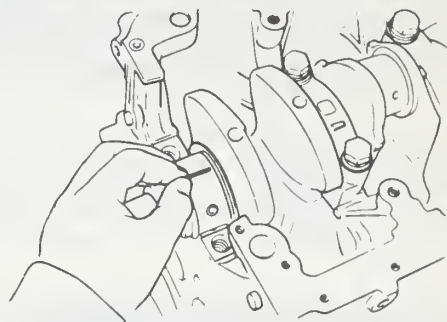
4. Remove the main bearing caps after they have been marked.

5. Remove the crankshaft from the block. The crankshaft, even from a small engine is heavy. Be prepared to control the weight, particularly if working under the engine.

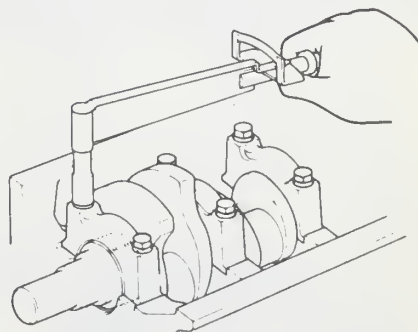
6. Follow the crankshaft inspection, main bearing clearance checking and replacement procedures before reinstalling the crankshaft.

INSPECTION

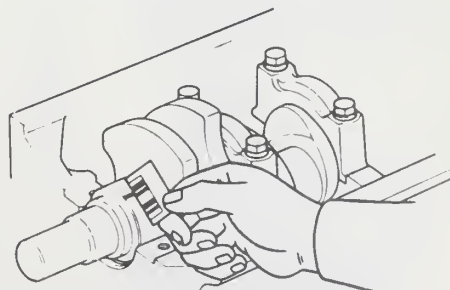
Crankshaft inspection and servicing should be handled exclusively by a reputable machinist, as most of the necessary procedures require a dial indicator, fixing jig, a large micrometer, and machine tools such as a crankshaft grinder. While at the machine shop, the crankshaft should be thoroughly cleaned (espe-



Use Plastigage® to check main bearing clearance



Tighten all main bearing caps to specification



Compare the width of the now-flattened Plastigage® with the scale on the envelope

3 ENGINE AND ENGINE OVERHAUL

cially the oil passages) and crack-checked. Additionally, have it checked for: main journal diameter, crank pin (connecting rod journal) diameter, taper, out-of-round, and run-out. Wear, beyond specification limits, in any of these areas means the crankshaft must be reground or replaced.

MAIN BEARING CLEARANCE CHECK

Checking main bearing clearances is done in the same manner as checking connecting rod clearances.

1. With the crankshaft installed, remove the main bearing cap to be checked. Clean all oil from the bearing insert in the cap and from the crankshaft journal, as the Plastigage® material is oil-soluble.

2. Lay a strip of Plastigage® along the full width of the bearing cap (or along the width of the crank journal if the engine is out of the truck and inverted).

3. Install the bearing cap and torque to specification.

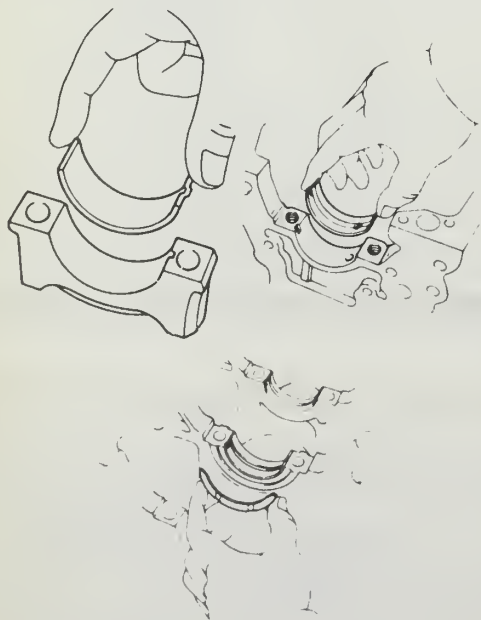
NOTE: Do not rotate the crankshaft with the Plastigage® installed.

4. Remove the bearing cap and determine bearing clearance by comparing the width of the now-flattened Plastigage® with the scale on the Plastigage® envelope. Journal taper is determined by comparing the width of the Plastigage® strip near its ends. Rotate the crankshaft 90° and retest, to determine journal eccentricity.

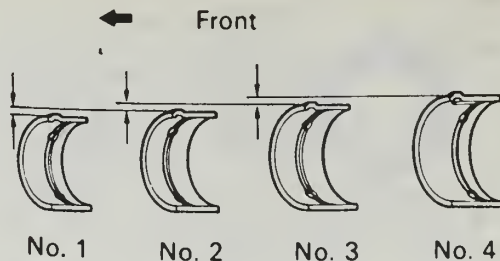
5. Repeat for the remaining bearings. If the bearing journal and insert appear in good shape (with no unusual wear visible) and are within tolerances, no further main bearing service is required. If unusual wear is evident and/or the clearances are outside specifications, the bearings must be replaced and the cause of their wear found.

MAIN BEARING REPLACEMENT

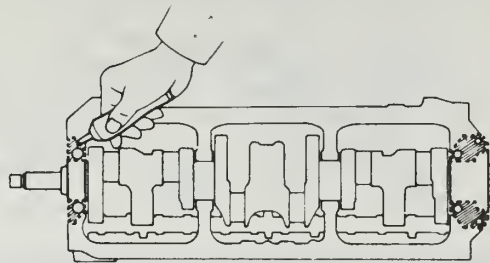
Main bearings can be replaced with the crankshaft in the engine (with the engine still in the truck) or with the engine on a work stand or bench. Both procedures are covered here. The main bearings must be replaced if the crankshaft has been re-



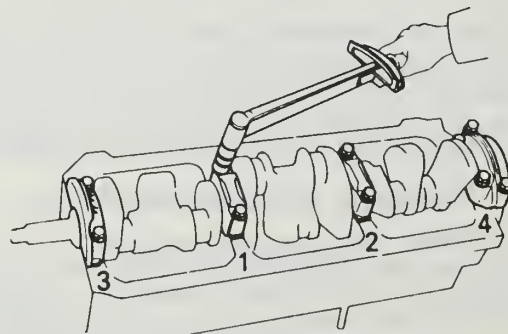
Correct installation of the bearings and thrust washers. The oil grooves face outward on the thrust washers



Pay attention. The outer diameters are each different on 3F-E main bearings



Apply sealant to the 3F-E main bearing cap contact points



Tighten the 3F-E bearing caps in this order

ground; the replacement bearing being available in various undersize increments from most auto parts jobbers or your Toyota dealer.

Engine Out of Truck

1. Remove the crankshaft from the engine block.

2. Remove the main bearing inserts from the bearing caps and from the main bearing saddles. Remove the thrust washers from the No. 3 (4 cylinder) or No. 4 (6 cylinder) crank journal.

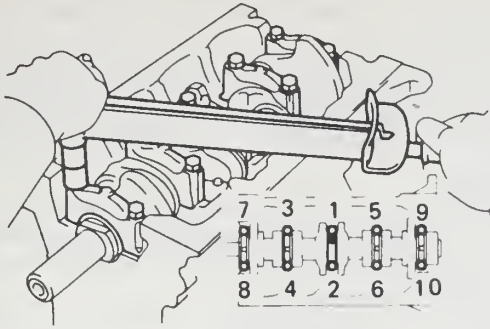
3. Thoroughly clean the saddles, bearing caps, and crankshaft.

4. Make sure the crankshaft has been fully checked and is ready for reassembly. Place the upper main bearings in the block saddles so that the oil grooves and/or oil holes are correctly aligned with their corresponding grooves or holes in the saddles. Note that on 3F-E, the outer diameter varies with each bearing location; additionally, all the main bearings have oil holes except Nos. 1 and 4 on the lower side.

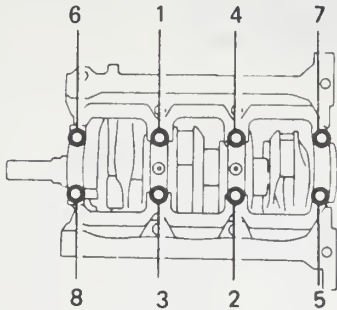
5. Install the thrust washers on the center main bearing, with the oil grooves facing out.

6. Lubricate the faces of all bearings with clean engine oil, and place the crankshaft in the block. On 3F-E, apply sealant to the block in the location of the front and rear main bearing cap contact points.

7. Install the main bearing caps in numbered order with the arrows or any other orientation marks facing forward. For the



Tighten bearing caps for 4-cylinder engines in this order



Use this order for tightening 3VZ-E main bearing cap bolts

22R, 22R-E and 3F-E, tighten the cap bolts in the correct sequence in two or three passes to the correct tightness. Rotate the crankshaft after each pass to ensure even tightness.

On 3VZ-E engines, once the caps are installed, bring the bolts to 45 ft. lbs. (61 Nm) in several passes and in the correct order. If any bolt will not tighten to this specification, the bolt must be replaced. Mark the front face of each bolt with paint; turn each bolt an additional 90° so that the paint marks now face the side of the engine. Check that the crankshaft turns smoothly.

8. Check the crankshaft thrust clearance (end play). If clearance is outside specifications (too sloppy), install a new set of oversize thrust washers and check clearance again.

Engine And Crankshaft Installed

1. Remove the main bearing caps and keep them in order.
2. Make a bearing roll-out pin from a cotter pin.
3. Use the cotter pin tool to carefully roll out the old bearing inserts from the upper side of the crankshaft journal, noting the positions of the oil grooves and/or oil holes so the new inserts can be correctly installed. This rolling-out of the bearing takes a light touch and a bit of patience. The bearing must be rotated a full 180° before it can be removed. Take great care not to mar or scratch the crank journal with the cotter pin.
4. Roll each new insert into its saddle after lightly oiling the crankshaft-side face of each. Make sure the notches and/or oil holes are correctly positioned.
5. Replace the bearing inserts in the caps with new inserts. Oil the face of each, and install the caps in numbered order with the arrows or other orientation marks facing forward.
6. Refer to Step 7 in the previous procedure for the correct re-assembly methods. Torque the bolts to the specified torque in two or three passes in the sequence shown.

Cylinder Block

Most inspection and service work on the cylinder block should be handled by a machinist or professional engine rebuilding

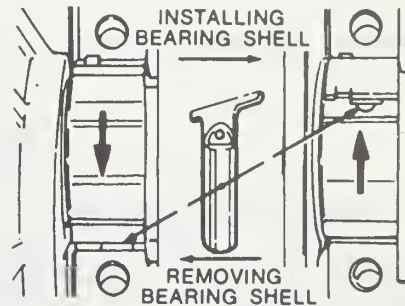
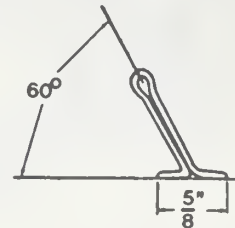
shop. Included in this work are bearing alignment checks, line boring, deck resurfacing, hot-tanking and cylinder honing or boring. A block that has been checked and properly serviced will last much longer than one which has not had the proper attention when the opportunity was there for it.

Cylinder de-glazing (honing) can, however, be performed by the owner/mechanic who is careful and takes the needed time to do it properly. The cylinder bores become glazed during normal operation as the rings continually ride up and down against them. This shiny glaze must be removed in order for a new set of piston rings to seat properly.

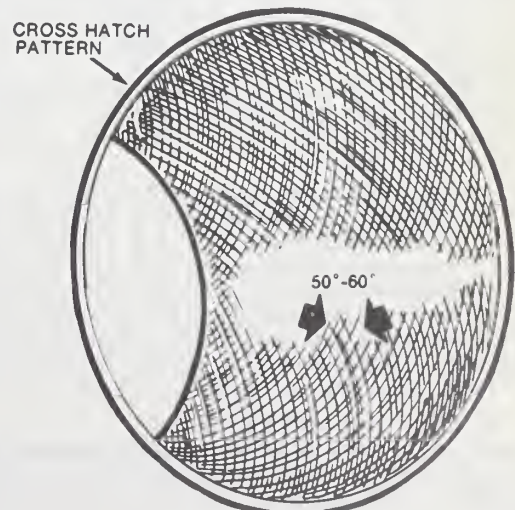
Cylinder hones are available at most auto tool stores and parts jobbers. With the piston and rod assemblies removed from the block, cover the crankshaft completely with a rag or cover to keep grit from the hone and cylinder material off it. Honing with the crankshaft removed is recommended if possible.

A cylinder hone with 3 flat faces or stones is vastly preferred over the beaded or bottle-brush type. Install the hone into a variable speed power drill (preferred in place of a constant speed drill), and insert it into the cylinder.

NOTE: Make sure the drill and hone are kept square to the cylinder bore throughout the entire honing operation.



A homemade tool is very handy sneaking the upper main bearings out with the crankshaft installed



Properly honed cylinders should have a pattern like

3 ENGINE AND ENGINE OVERHAUL

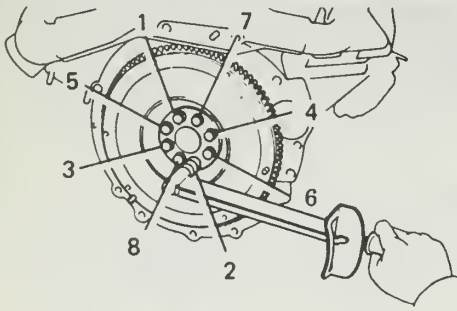
Start the hone and move it up and down in the cylinder at a rate which will produce approximately a 60° cross-hatch pattern. DO NOT extend the hone below the cylinder bore. After developing the pattern, remove the hone and recheck piston fit. Wash the cylinders with a detergent and water solution to remove the hone and cylinder grit. Wipe the bores out several times with a clean rag soaked in clean engine oil. Remove the cover from the crankshaft, and check closely to see that no grit has found its way onto the crankshaft. The honing grit will instantly destroy any bearing surface it contacts.

Flywheel and Ring Gear

REMOVAL AND INSTALLATION

All Engines

1. If the engine is installed in the vehicle, remove the transmission.



Flywheel bolt tightening pattern for 3VZ-E

2. Remove the clutch assembly, if equipped with manual transmission.

3. Make matchmarks on the flywheel and crankshaft end. Loosen the bolts holding the flywheel or driveplate a little at a time and in a criss-cross pattern. Remove the flywheel; it is heavy. Protect the flywheel and ring-gear from damage or impact.

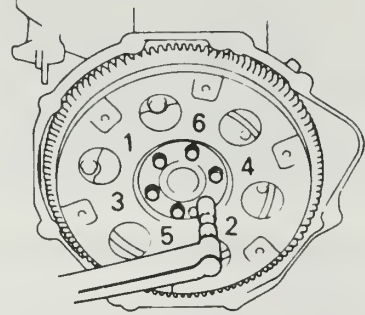
To install:

4. Thoroughly clean the flywheel bolts. For 3VZ-E and 3F-E engines, coat the first 3 or 4 threads of each bolt with sealant. Install the flywheel, aligning the previously made marks. Install the bolts finger tight.

5. Torque the bolts in a criss-cross pattern and in several passes to the correct tightness:

- 22R/22R-E, manual trans: 80 ft. lbs. (108 Nm)
- 3VZ-E with manual trans: 65 ft. lbs. (88 Nm)
- 22R/22R-E and 3VZ-E, auto. trans: 61 ft. lbs. (83 Nm)
- 3F-E: 64 ft. lbs. (87 Nm)

6. Reinstall the transmission.



Tighten the 3F-E flywheel bolts in a criss-cross pattern

EXHAUST SYSTEM

Safety Precautions

For a number of reasons, exhaust system work can be the most dangerous type of work you can do on your car. Always observe the following precautions:

- Support the car extra securely. Not only will you often be working directly under it, but you'll frequently be using a lot of force, such as heavy hammer blows, to dislodge rusted parts. This can cause a vehicle that's improperly supported to shift and possibly fall.

- Wear goggles. Exhaust system parts are always rusty. Metal chips can be dislodged, even when you're only turning rusted bolts. Attempting to pry pipes apart with a chisel makes the chips fly even more frequently.

- If you're using a cutting torch, keep it a great distance from either the fuel tank or lines. Stop what you're doing and feel the temperature of the fuel pipes on the tank frequently. Even slight heat can expand and/or vaporize fuel, resulting in accumulated vapor (or even a liquid leak) near your torch.

- Watch where your hammer blows fall and make sure you hit squarely. You could easily tap a brake or fuel line when you hit an exhaust system part with a glancing blow. Inspect all lines and hoses in the area where you've been working.

CAUTION

Be very careful when working on or near the catalytic converter. External temperatures can reach 1,500°F (816°C) and more, causing severe burns. Removal or installation should be performed only on a cold exhaust system.

Special Tools

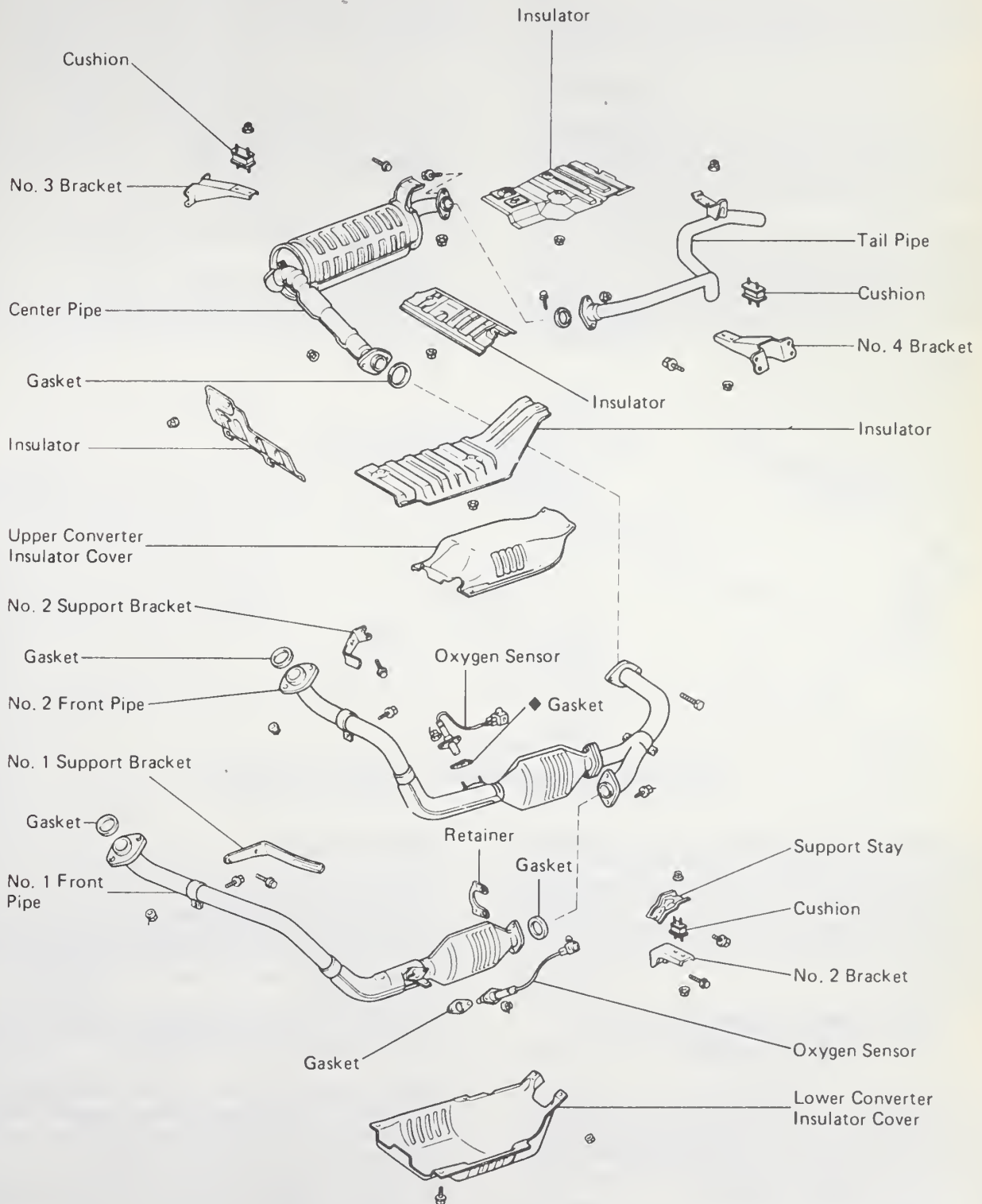
A number of special exhaust system tools can be rented from auto supply houses or local stores that rent special equipment. A common one is a tail pipe expander, designed to enable you to join pipes of identical diameter.

It may also be quite helpful to use solvents designed to loosen rusted bolts or flanges. Soaking rusted parts the night before you do the job can speed the work of freeing those parts considerably. Remember that these solvents are often flammable. Apply only to parts after they are cool.

The exhaust system of Toyota trucks consists of several pieces. At the front of a 4-cylinder vehicle, the first section of pipe connects the exhaust manifold to the catalytic converter. The V-6 3VZ-E uses a crossover or Y-pipe below the engine to connect the two exhaust manifold ports. The in-line 6-cylinder 3F-E uses a Y-pipe to connect the two outputs from the exhaust manifold. The catalytic converter is a sealed, non-serviceable unit which can be easily unbolted from the system and replaced if necessary.

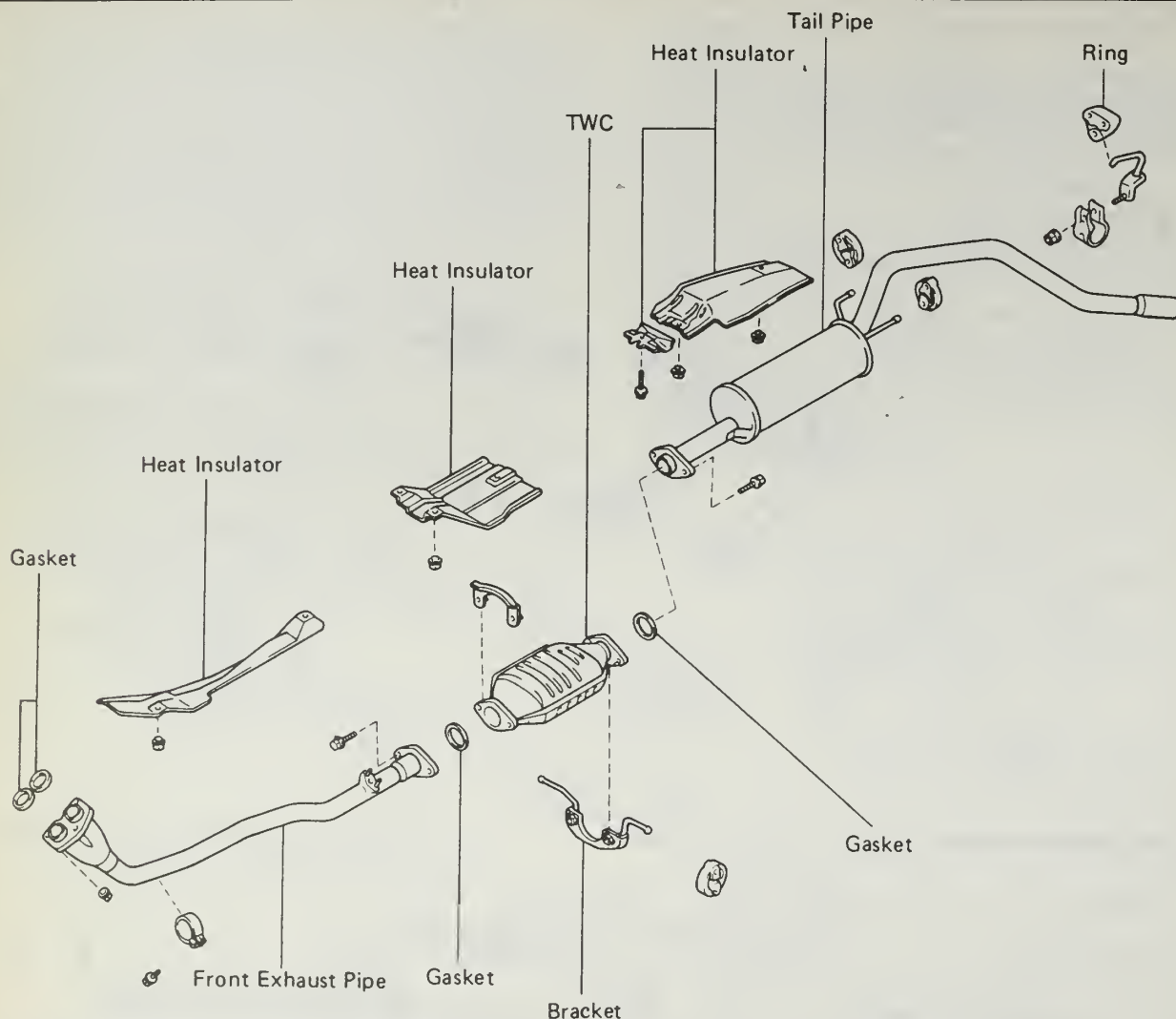
The exhaust system is attached to the body by several welded hooks and flexible rubber hangers; these hangers absorb exhaust vibrations and isolate the system from the body of the car. A series of metal heat shields runs along the exhaust piping, protecting the underbody from excess heat.

When inspecting or replacing exhaust system parts, make sure there is adequate clearance from all points on the body to avoid possible overheating of the floorpan. Check the complete system for broken damaged, missing or poorly positioned parts.



Land Cruiser exhaust system components

3 ENGINE AND ENGINE OVERHAUL



Exhaust system components – Trucks and 4Runner

Rattles and vibrations in the exhaust system are usually caused by misalignment of parts. When aligning the system, leave all the nuts and bolts loose until everything is in its proper place, then tighten the hardware working from the front to the rear. Remember that what appears to be proper clearance during repair may change as the truck moves down the road. The motion of the engine, body and suspension must be considered when replacing parts.

COMPONENT REMOVAL AND INSTALLATION

CAUTION

Do NOT perform exhaust repairs with the engine or exhaust hot. Allow the system to cool completely before attempting any work.

Exhaust systems are noted for sharp edges, flaking metal and rusted bolts. Gloves and eye protection are required. A healthy supply of penetrating oil and rags is highly recommended.

NOTE: ALWAYS use a new gasket at each pipe joint whenever the joint is disassembled. Use new nuts and bolts to hold the joint properly. These two low-cost items will serve to prevent future leaks as the system ages.

Catalytic Converter

1. Raise and support the truck on jackstands.
2. Remove the heat shield(s).
3. On 3F-E, disconnect the oxygen sensor connector. Remove the bolt holding the oxygen sensor and remove the sensor. Protect the tip of the sensor from damage and do not place it on or near any petroleum based solvents. This includes not putting it on a greasy rag.
4. Remove the four bolts at the front and rear of the converter. On 3F-E, disconnect the converter pipe from the manifold first, then disconnect it at the Y-pipe.

NOTE: Always support the pipe running to the manifold, either by the normal clamps/hangers or by using string, stiff wire, etc. If left loose, the pipe can develop enough leverage to crack the manifold.

5. Remove the converter and gaskets.
6. Using new gaskets, connect the converter to the exhaust pipes. Tighten the bolts to 29 ft. lbs. (39 Nm).
7. On 3F-E, install the oxygen sensor and tighten the nuts to 14 ft. lbs. (20 Nm). Don't forget to connect the wire harness.
8. On 3F-E, attach the pipe to the manifold (with a new gasket) and tighten the nuts to 46 ft. lbs. (62 Nm).

Muffler and/or Tail Pipe

The muffler and tail pipe on trucks and 4Runner is one piece and should be replaced as a unit. On the Land Cruiser, the tailpipe can be unbolted from the muffler. Both mufflers include the lead-in pipe to the muffler. All Toyota exhaust components bolt together with gaskets at the joints; no welding is involved. To remove the muffler and/or tailpipe:

1. Elevate and firmly support the rear of the vehicle.
2. Disconnect the nuts holding the muffler and/or tailpipe to the adjacent pipes.
3. remove or disconnect the clamps and supports holding the pipe at either end. Leave the supports closest to the center in place until last.
4. Remove the last supports or hangers and lower the unit to the ground. At NO TIME should the muffler be allowed to hang partially supported; the leverage can break the next component in line.

NOTE: If the muffler or tailpipe is being replaced due to rust or corrosion, adjacent pipes should be checked for the same condition. The pieces tend to age at about the same rate.

5. Lift the new unit into place and loosely attach the hangers or supports to hold it in place. Allow some play to adjust the muffler.

6. Using new gaskets, connect each end to the adjoining pipe. Tighten the joint bolts and nuts to 29 ft. lbs. (39 Nm).

7. Tighten the supports and hangers. Make certain the rubber hangers are securely attached to their mounts.

Complete System

If the entire exhaust system is to be replaced, it is much easier to remove the system as a unit than remove each individual piece. Disconnect the first pipe at the manifold joint and work towards the rear removing brackets and hangers as you go. Remove the rear muffler bracket and slide the entire exhaust system out from under the car.

The new system can then be bolted up on the workbench and easily checked for proper tightness and gasket integrity. When installing the new assembly, suspend it from the flexible hangers first, then attach the fixed (solid) brackets. Check the clearance to the body and suspension and install the manifold joint bolts, tightening them correctly.

TORQUE SPECIFICATIONS

Component	English	Metric
Air Conditioning Compressor mounting bolts:	18 ft. lbs.	25 Nm
Air injection manifold union nuts/bolts 3F-E:	15 ft. lbs.	21 Nm
Air intake chamber-to-throttle body 22R 22R-E:	14 ft. lbs.	19 Nm
3VZ-E:	13 ft. lbs.	18 Nm
Alternator adjusting bar:	9 ft. lbs.	13 Nm
Camshaft bearing caps 3VZ-E:	12 ft. lbs.	16 Nm
22R, 22R-E:	13-16 ft. lbs.	18-22 Nm
Camshaft pulley bolts 3VZ-E:	80 ft. lbs.	108 Nm
Camshaft sprocket bolt 22R, 22R-E:	58 ft. lbs.	78 Nm
Camshaft thrust washer bolts 3F-E:	9 ft. lbs.	12 Nm
Catalytic Converter-to-exhaust pipe	29 ft. lbs.	39 Nm
Clutch release cylinder and bracket 22R and 22R-E		
Bracket bolts:	29 ft. lbs.	39Nm
Cylinder bolts:	9 ft. lbs.	13 Nm
Cold start injector tube union bolt 3VZ-E:	13 ft. lbs.	18 Nm
Connecting Rod nuts 22R, 22R-E:	51 ft. lbs.	69 Nm
3F-E:	43 ft. lbs.	59 Nm
3VZ-E:	18 ft. lbs.*	25 Nm*
*Plus a 90° (¼) turn		
Crankshaft pulley bolt 22R and 22R-E:	116 ft. lbs.	157 Nm
3F-E:	253 ft. lbs.	343 Nm
3VZ-E:	181 ft. lbs.	245 Nm
Crossover pipe 3VZ-E:	29 ft. lbs.	39 Nm

3 ENGINE AND ENGINE OVERHAUL

TORQUE SPECIFICATIONS

Component	English	Metric
Cylinder Head, 3 passes to:		
22R:	58 ft. lbs.	78 Nm
22R-E:	58 ft. lbs.	78 Nm
3F-E:	90 ft. lbs.	123 Nm
3VZ-E		
Exc. bolt No.9:	33 ft. lbs.*	45 Nm*
Bolt No.9, torqued last:	27 ft. lbs.*	37 Nm*
*Plus 90° (1/4) turn		
See text illustration for bolt numbers		
Cylinder head cover nuts		
22R, 22R-E and 3F-E:	48 inch lbs.	5Nm
3VZ-E:	5-6 ft. lbs.	7-8 Nm
Distributor pinch bolt:	14 ft. lbs.	19 Nm
EGR valve		
3VZ-E		
A:	9 ft. lbs.	12 Nm
B:	13 ft. lbs.	18 Nm
C:	22 ft. lbs.	29 Nm
See text illustration for bolt numbers		
Engine Mounts		
Rear engine mount-to-support		
22R, 22R-E, 3VZ-E:	9 ft. lbs.	13 Nm
No.2 crossmember-to-frame		
22R 22RE, and 3VZ-E, 4WD models:	70 ft. lbs.	95 Nm
Extension housing mounting bolts		
22R and 22RE, 3VZ-E, 2WD models:	to 19 ft. lbs.	25 Nm
Crossmember-to-chassis		
3F-E		
Bolts:	29 ft. lbs.	39 Nm
Nuts:	43 ft. lbs.	59 Nm
Exhaust Manifold		
22R, 22R-E:	30 ft. lbs.	40 Nm
3VZ-E:	22 ft. lbs.	29 Nm
Exhaust pipe-to-manifold nuts		
3F-E:	46 ft. lbs.	62 Nm
22R, 22R-E, and 3VZ-E:	30 ft. lbs.	40 Nm
Fan pulley bracket		
3VZ-E:	30 ft. lbs.	41 Nm
Flywheel and Ring Gear		
22R/22R-E, manual trans:	80 ft. lbs.	108 Nm
3VZ-E with manual trans:	65 ft. lbs.	88 Nm
22R/22R-E and 3VZ-E, auto. trans:	61 ft. lbs.	83 Nm
3F-E:	64 ft. lbs.	87 Nm
Front and rear driveshaft nuts:	65 ft. lbs.	88 Nm
Fuel delivery pipe bolts		
3VZ-E:	9 ft. lbs.	13 Nm
Fuel pipe union bolts		
3VZ-E:	22 ft. lbs.	29 Nm
Fuel hose-to-the delivery pipe bolt		
22R-E:	33 ft. lbs.	44 Nm
Idler pulley bolt		
3VZ-E:	27 ft. lbs.	37 Nm
Injection manifold-to-cylinder head		
3VZ-E:	27 ft. lbs.	37 Nm
Intake manifold bolts and nuts		
3VZ-E:	13 ft. lbs.	18 Nm
22R 22R-E:	14 ft. lbs.	19 Nm

TORQUE SPECIFICATIONS

Component	English	Metric
Intake and exhaust manifolds		
3F-E		
A-17mm bolts:	51 ft. lbs.	69 Nm
B-14mm bolts:	37 ft. lbs.	50 Nm
C-nuts:	41 ft. lbs.	56 Nm
See text illustration for bolt letters		
Intake Manifold heat shield bolts		
3F-E:	9 Ft. lbs.	12 Nm
Intake manifold support		
3VZ-E:		
Group A bolts:	9 ft. lbs.	12 Nm
Group B bolts:	13 ft. lbs.	18 Nm
Group C bolts:	22 ft. lbs.	29 Nm
3F-E:	22 ft. lbs.	29 Nm
See text illustration for bolt letters		
Main Bearings		
22R, 22R-E:	76 ft. lbs.	103 Nm
3VZ-E:	45 ft. lbs.*	61 Nm*
3F-E		
19mm bolts:	99 ft. lbs.	135 Nm
17mm bolts:	85 ft. lbs.	116 Nm
*Plus a 90° (¼) turn		
Muffler and/or Tail Pipe:	29 ft. lbs.	39 Nm
Oil pan nuts and bolts		
22R and 22R-E:	9 ft. lbs.	13 Nm
3VZ-E:	52 inch lbs.	5.9 Nm
Oil Pump		
22R and 22R-E		
A:	18 ft. lbs.	25 Nm
B:	14 ft. lbs.	19 Nm
C:	9 ft. lbs.	13 Nm
3VZ-E:	14 ft. lbs.	20 Nm
3F-E		
1 & 2:	33 ft. lbs.	44 Nm
3:	13 ft. lbs.	18 Nm
See text illustration for bolt letters		
Oil pump relief valve plug		
22R and 22R-E:	27 ft. lbs.	37 Nm
Oil strainer		
22R and 22R-E:	9 ft. lbs.	13 Nm
3VZ-E:	61 inch lbs.	7 Nm
3F-E:	10 ft. lbs.	13 Nm
Oxygen sensor nuts:	14 ft. lbs.	20 Nm
Power steering bracket and compressor support bolts		
22R, 22R-E:	33 ft. lbs.	44 Nm
Power steering pump pulley lock nut		
22R, 22R-E, and 3VZ-E:	32 ft. lbs.	43Nm
3F-E:	35 ft. lbs.	47 Nm
Power steering pulley-to-crankshaft		
3F-E:	13 ft. lbs.	18 Nm
Pushrod cover		
3F-E:	35 inch lbs.	4 Nm
3VZ-E:	35 inch lbs.	4 Nm
Refrigerant lines-to-compressor		
Suction line:	24 ft. lbs.	32 Nm
Discharge line:	16 ft. lbs.	22 Nm

3 ENGINE AND ENGINE OVERHAUL

TORQUE SPECIFICATIONS

Component	English	Metric
Refrigerant lines-to-condenser		
Discharge hose:	14 ft. lbs.	18 Nm
Refrigerant line-to-receiver:	48 inch lbs.	5 Nm
Rocker shaft-to-cylinder head:		
3F-E		
12mm:	17 ft. lbs.	24 Nm
14mm:	25 ft. lbs.	33 Nm
Starter bolts:	29 ft. lbs.	39 Nm
Timing belt cover bolts		
3VZ-E:	74 inch lbs.	8.3 Nm
Timing chain cover bolt		
22R and 22R-E		
8mm bolts:	9 ft. lbs.	13 Nm
10mm bolts:	29 ft. lbs.	39 Nm
Timing gear cover bolts		
3F-E		
Bolts marked A:	18 ft. lbs.	25 Nm
Bolts marked B or C:	43 inch lbs.	5 Nm
See text illustration for bolt letters		
Valve cover nuts		
3F-E:	78 inch lbs.	8.8 Nm
Water bypass outlet bolts		
3VZ-E:	13 ft. lbs.	18 Nm
Water outlet		
3F-E:	10-14 ft. lbs	14-19 Nm
Water Pump mounting bolts		
22R and 22R-E:	27 ft. lbs.	37 Nm
3F-E:	27 ft. lbs.	37 Nm
3VZ-E		
Bolts marked A:	13 ft. lbs.	18 Nm
Bolts marked B:	14 ft. lbs.	20 Nm
Water outlet		
3F-E:	18 ft. lbs.	25 Nm
Water bypass outlet		
3VZ-E:	13 ft. lbs.	18 Nm

4

Emission Controls

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4 EMISSION CONTROLS

EMISSION CONTROLS

Component location and vacuum routing diagrams are located at the end of this Section. Please refer to them before beginning any disassembly or testing.

There are three sources of automotive pollutants; crankcase fumes, exhaust gases, and gasoline evaporation. The pollutants formed from these substances fall into three categories: unburnt hydrocarbons (HC), carbon monoxide (C), and oxides of nitrogen (NOx). The equipment used to limit these pollutants is called emission control equipment and is required by national and state or provincial laws.

Due to varying state, federal, and provincial regulations, specific emission control equipment have been devised for each. The U.S. emission equipment is divided into two categories: California and 49 State (Federal). In this section, the terms "California", "Calif." or "Cal" applies only to vehicles originally built to be sold in California. California emissions equipment includes the Federal equipment as well as other items required by California's more stringent regulations. Models built to be sold in Canada also have specific emissions equipment, although in most years Federal and Canadian equipment is the same.

NOTE: Many emissions components are referred to by possibly confusing abbreviations. To keep your HIC, HAC and HAI in good order, refer to the abbreviations list for explanation.

Positive Crankcase Ventilation (PCV) System

OPERATION

A closed, positive crankcase ventilation system is employed on

all Toyota trucks. This system cycles incompletely burned fuel (which works its way past the piston rings) back into the intake manifold for reburning with the air/fuel mixture. The oil filler cap is sealed; and the air is drawn from the top of the crankcase into the intake manifold through a valve with a variable orifice.

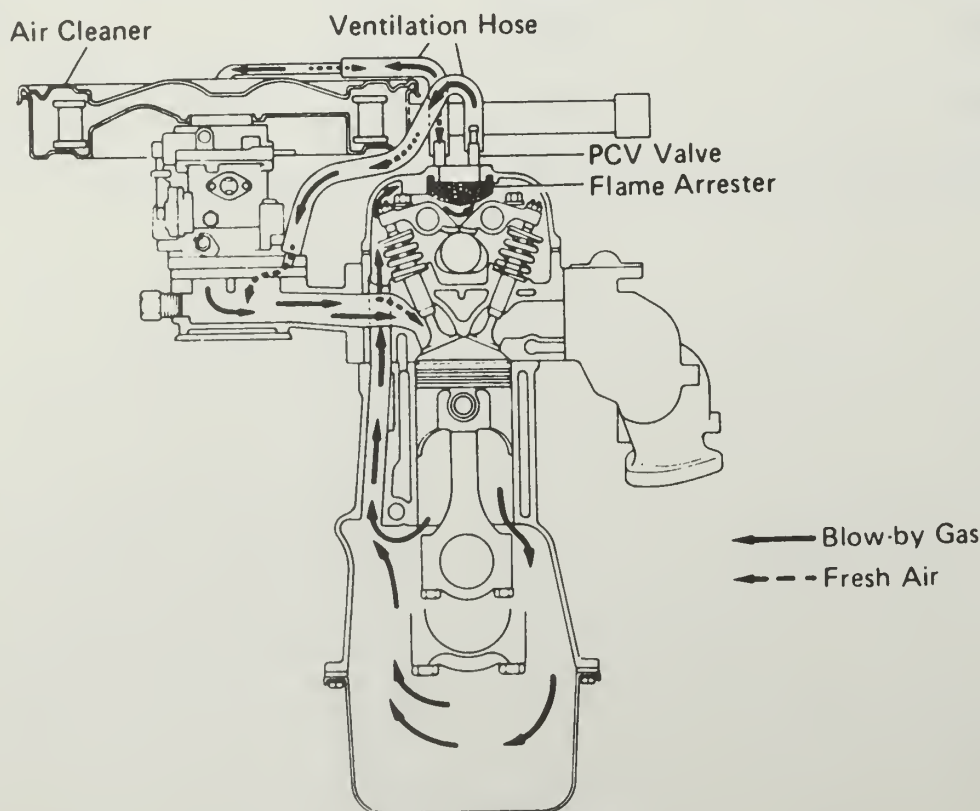
This valve (commonly known as the PCV valve) regulates the flow of air into the manifold according to the amount of manifold vacuum. When the throttle plates are open fairly wide, the PCV valve opens to maximize the flow. However, at idle speed, when manifold vacuum is at a maximum, the PCV valve reduces the flow in order not to unnecessarily affect the small volume of mixture passing into the engine.

During most driving conditions, manifold vacuum is high and all of the vapor from the crankcase, plus a small amount of excess air, is drawn into the manifold via the PCV valve. However, at full throttle, the increase in the volume of blow-by and the decrease in manifold vacuum make the flow via the PCV valve inadequate. Under these conditions, excess vapors are drawn into the air cleaner and pass into the engine.

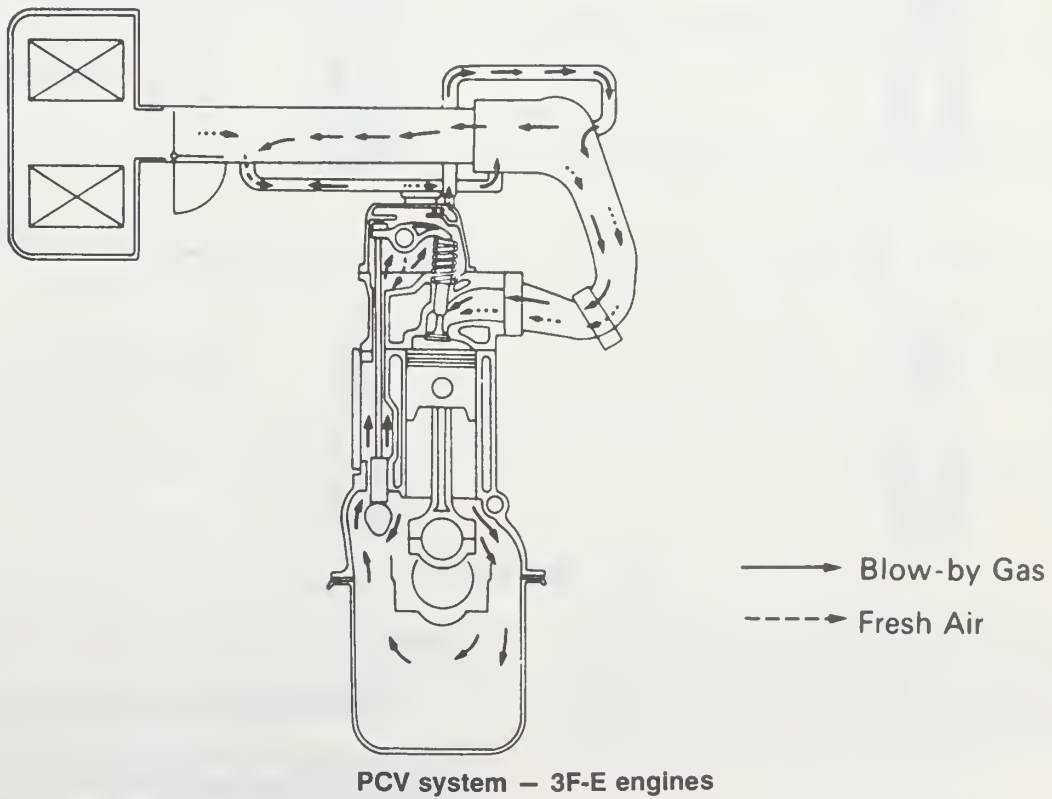
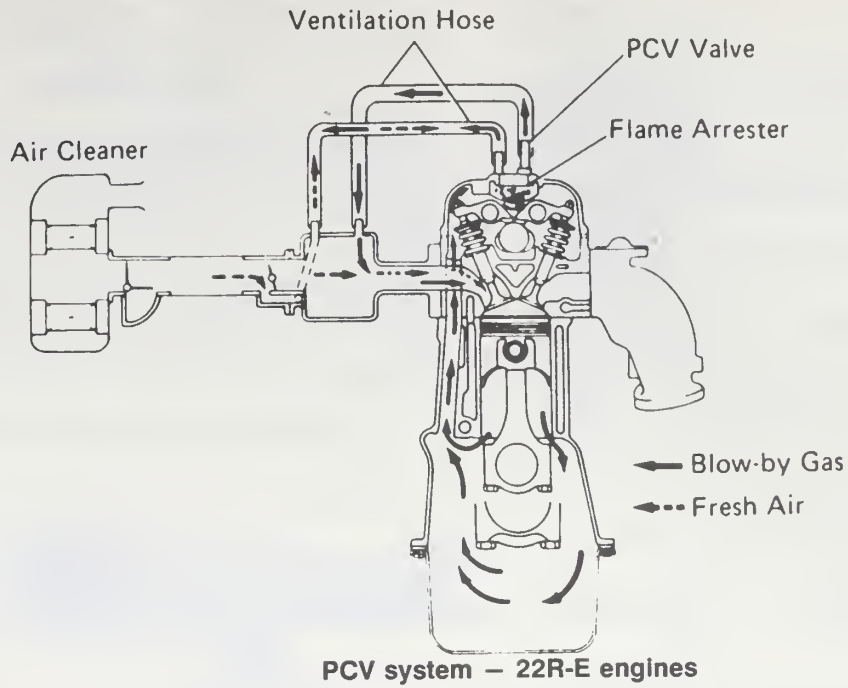
This recirculation system relies on the integrity of the engine seals. Any air leak around a valve cover, head gasket, oil pan, dipstick, oil filler cap, air intake ducts, or vacuum or breather hoses can introduce excess air into the fuel/air mixture, causing rough running or reduced efficiency. Likewise, a plugged hose or passage can cause sludging, stalling and oil leaks.

TESTING AND TROUBLESHOOTING

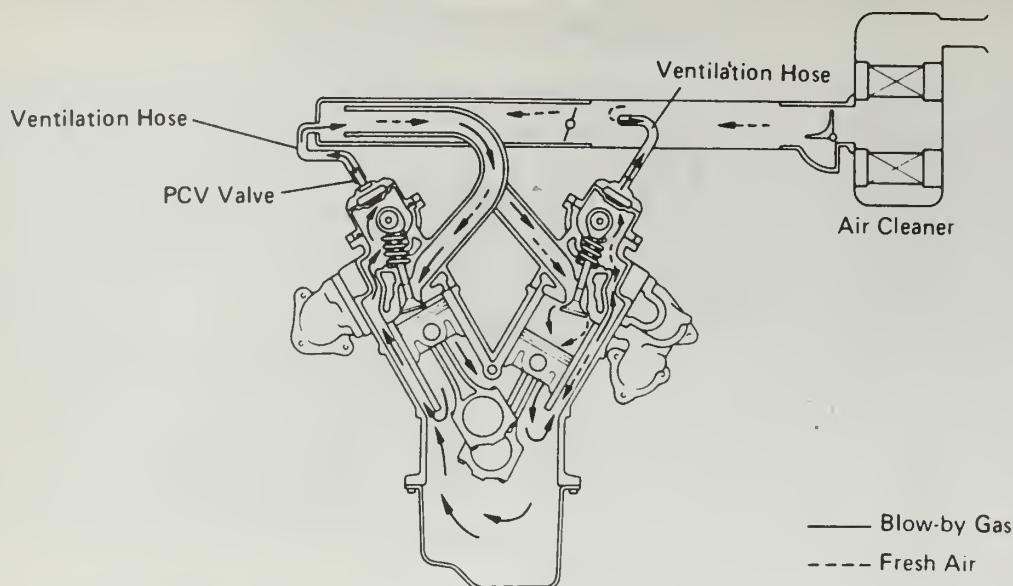
The PCV valve is easily checked with the engine running at normal idle speed (warmed up). Remove the PCV valve from the valve cover or intake manifold, but leave it connected to its hose. Place your thumb over the end of the valve to check for vacuum.



PCV system — 22R engines



4 EMISSION CONTROLS



PCV system — 3VZ-E engines

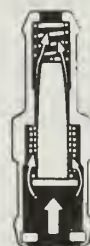
Engine not Running or Backfiring
Intake Manifold Side



- PCV VALVE IS CLOSED

Cylinder Head Side

Normal Operation



- PCV VALVE IS OPEN.
- VACUUM PASSAGE IS LARGE.

Idling or Decelerating



- VACUUM PASSAGE IS SMALL.

Acceleration or High Load



- PCV VALVE IS FULLY OPEN.

PCV valve function

If there is no vacuum, check for plugged hoses or ports. If these are open, the valve is faulty. With the engine OFF, remove the valve completely. Shake it end to end, listening for the rattle of the needle inside the valve. If no rattle is heard, the needle is jammed (probably with oil sludge) and the valve should be replaced.

NOTE: Don't blow directly into the valve; petroleum deposits within the valve can be harmful.

An engine operated without crankcase ventilation is quickly

damaged. It is important to check the PCV at regular maintenance intervals.

REMOVAL AND INSTALLATION

1. Remove the PCV valve from the cylinder head cover.
2. Remove the hose from the valve.
3. Check the valve for proper operation and then insert it into the hose.
4. Insert the other end of the PCV valve into the cylinder head cover. Make certain it is firmly pushed into the rubber grommet.

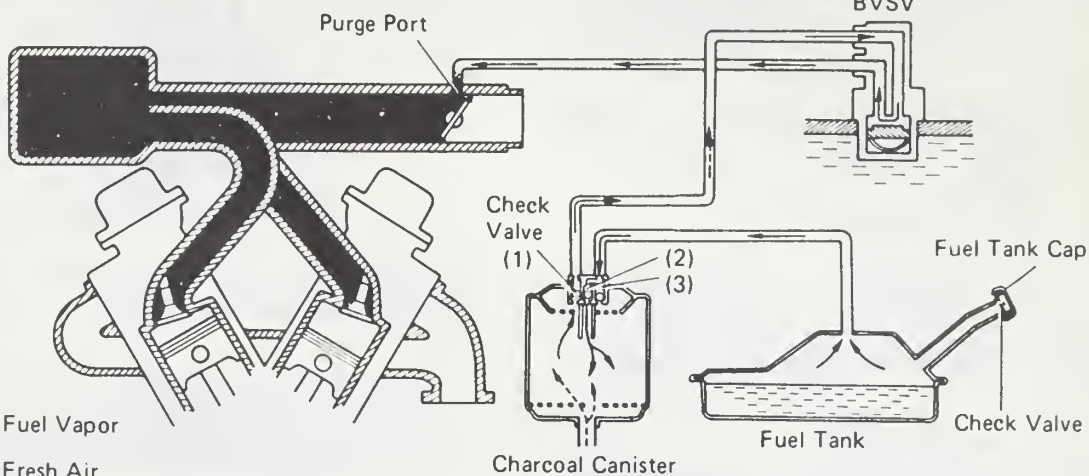
Evaporative Emission Control System

OPERATION

To prevent hydrocarbon emissions from entering the atmosphere due to the evaporation of fuel in the tank and carburetor (22R only) Toyota trucks are equipped with evaporative emission control (EVAP) systems. Collected vapors are stored in the charcoal canister.

The canister contains an air filter which cannot be removed but should be cleaned periodically. This system also employs:

1. A sealed fuel filler cap with a safety valve.
2. An activated charcoal canister with check valves.
3. A vacuum control valve (VCV)—3F-E.
4. A vacuum switching valve (VSV)—carbureted engines only.
5. A thermostatic vacuum switching valve (TVSV)—1980-82 only.



Example of evaporative control system. Basic system same for all vehicles, but external valving will vary by year and model

6. A bi-metal vacuum switching valve (BVS)—3VZ-E and 3F-E.
7. An outer vent control valve—carbureted engines only..

SERVICE

Checking the Filler Cap

Check that the filler cap seals effectively. Remove the filler cap and inspect the gasket. Replace the filler cap if the seal (gasket) is defective or if it is not operating properly.

Checking the Charcoal Canister and Check Valves

Remove the charcoal canister from the engine compartment and visually inspect it for cracks or other damage.

Check the canister for correct air flow and check-valve function. If compressed air is not available, a simple check can be performed by blowing into the ports. Use a clean piece of tubing or a straw to fit over each port; do not put the port in your mouth. Always blow through the tubing; never test with suction. Stored fumes are poisonous.

1. Using low pressure compressed air, blow into the tank pipe. (The tank pipe is the fitting with the flange on the end.) The air should flow from the other pipes without resistance.
2. If the air flow is incorrect, the check valve will require replacement.
3. Before installing the canister, clean the filter. Blow compressed air into the purge pipe while keeping the other blocked

with your fingers. The air flow will evaporate stored vapors within the canister.

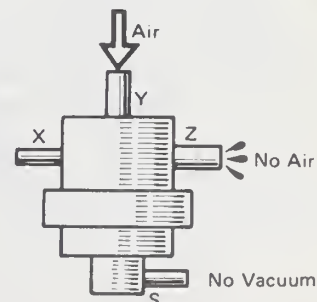
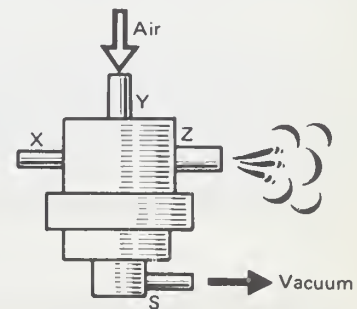
4. If liquid fuel is seen dripping from the canister, it is saturated beyond cleaning. Safely discard the canister and replace it with a fresh one.

NOTE: Do not attempt to wash the charcoal canister. While cleaning the canister, under no circumstances should any activated charcoal be removed.

Checking the Vacuum Control Valve (VCV)

3F-E

1. Locate the VCV by the intake air chamber and remove all the vacuum lines.
2. Apply vacuum to pipe S, blow air into pipe Y and check that air comes out of pipe Z.
3. Stop the vacuum and blow air into pipe Y again and check that air does not come out of pipe Z.



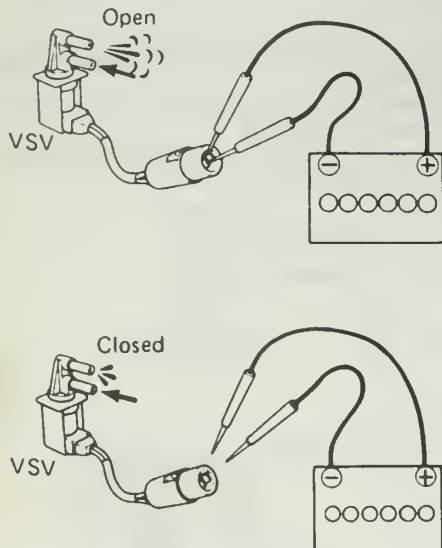
The two steps in checking VCV on 3F-E

4 EMISSION CONTROLS

4. If the valve is not operating properly, it will require replacement.

22R

1. Disconnect the VSV electrical connector.
2. Connect the VSV terminals to the battery terminals.
3. Blow into the pipe and check that the valve is open.
4. Disconnect the positive battery terminal.
5. Blow into the pipe and check that the valve is closed.
6. If the valve is not operating properly it will require replacement.



The 22R VCV should only open when power is applied

SPEED SENSOR FOR 22R VSV

1. Use a three-way connector to install a vacuum gauge into the line between the VSV and the canister. Place the gauge where it can be seen from the driver's seat under normal driving conditions.
2. Warm up the engine. Test drive the vehicle. The vacuum gauge should indicate zero vacuum below 7 mph.
3. Above 16 mph, the vacuum should rise to intake manifold vacuum. The vacuum level will rise and fall with engine rpm.
4. If the gauge does not indicate the correct relative levels, check the speed sensor.

Checking the Bimetal Vacuum Switching Valve (BVSF)

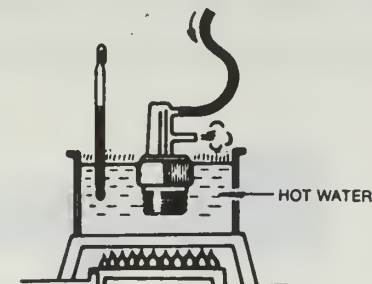
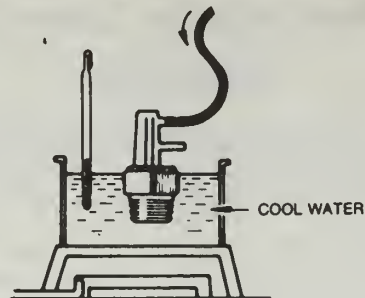
3VZ-E

1. Drain the engine coolant and remove the BVSF from the intake manifold.

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by the ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old.

2. Place the end of the BVSF in cool water and blow into the top connection. The valve should be closed.
3. Heat the water to a temperature above 129°F (54°C) and again blow into the top connection. This time, the valve should be open.
4. If the valve is not operating properly, it will require replacement.

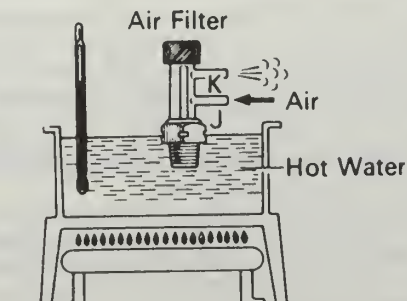
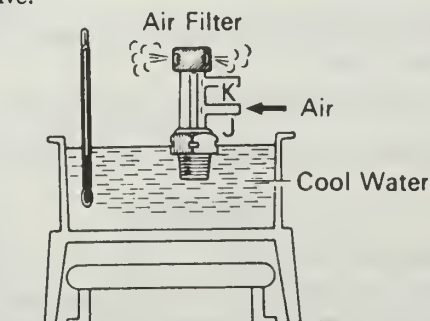


Checking the 3VZ-E BVSF

5. Apply liquid sealer to the threads and reinstall the BVSF, tightening it to 18 ft. lbs. (25 Nm).
6. Refill the engine with coolant.

3F-E

1. Drain the engine coolant and remove the BVSF from the water outlet on the engine block.
2. Place the end of the BVSF in cool water and blow into the bottom connection. The air should come out of the air filter on top of the valve.



The 3F-E BVSF should change airflow above 147°F (64°C)

3. Heat the water to a temperature above 147°F (64°C) and again blow into the bottom connection. This time, the air should come out of the upper pipe and not the filter.

4. If the valve is not operating properly, it will require replacement.

5. Apply liquid sealer to the threads and reinstall the BVSV, tightening it to 18 ft. lbs. (25 Nm).

6. Refill the engine with coolant.

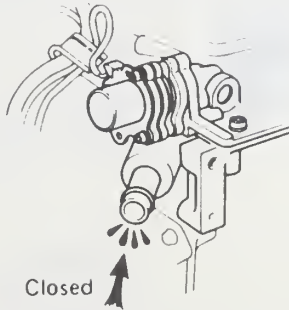
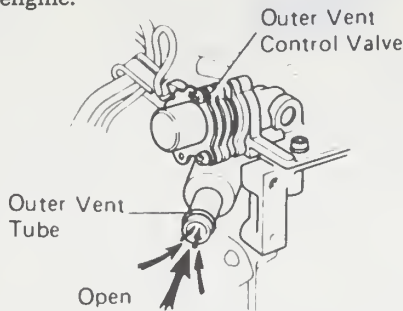
Checking the Outer Vent Control Valve

22R

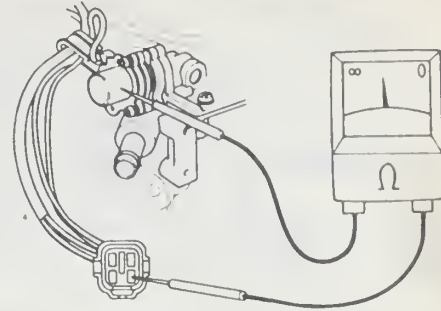
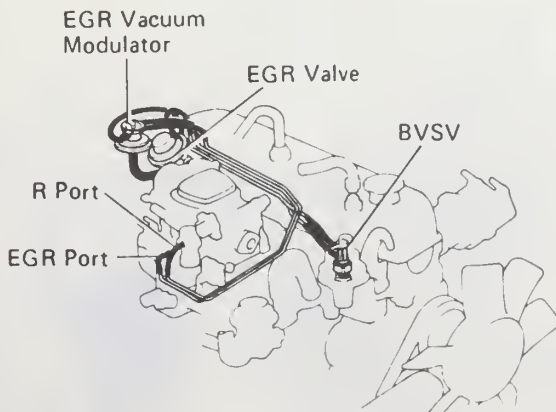
1. Disconnect the outer vent hose at the carburetor.

2. Blow air into the outer vent pipe and check that the control valve is open.

3. Start the engine.



Checking the outer vent control valve is done first with the engine off (upper) and then with the engine running



Testing the outer vent control valve solenoid

4. With the engine running at idle, blow air into the outer vent pipe and check that the control valve is closed.

5. Unplug the control valve electrical connector and check the resistance between the positive terminal in the connector and the solenoid body. Resistance should be 63-73Ω at 68°F (20°C). Resistance will vary with temperature; use good judgment when testing.

6. Replace the outer vent control valve if it fails either test.

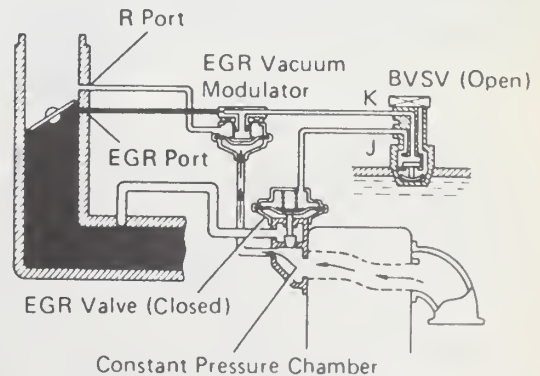
Exhaust Gas Recirculation System (EGR)

OPERATION

Oxides of nitrogen can only be formed under conditions of high pressure and very high temperature. Reduction of one of these conditions reduces the production of NOx. A reduction of peak combustion temperature is accomplished by recirculating a small amount of exhaust gas into the combustion chamber.

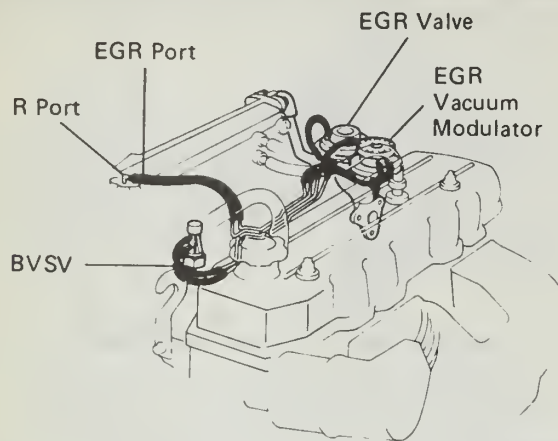
This metering of exhaust gas must be carefully monitored. Too much at the wrong time causes extremely poor driveability; too little and the emissions can increase dramatically. EGR function is overseen by an EGR modulator which controls the flow of vacuum (and therefore the flow of exhaust gas), limiting it to times when the presence of exhaust gas will not adversely affect the running of the engine. The 22R and 22R-E use a BVSV to sense the coolant temperature; in this way, EGR function is limited to warm engine operation. The 3VZ-E and 3F-E engines use a vacuum solenoid valve connected to the Engine Control Unit (ECU). The computer receives many inputs regarding engine status and temperature; when conditions are favorable, the VSV is activated, allowing EGR function.

Additionally, EGR function is controlled by manifold vacuum so that the valve only during periods of high-load or high rpm

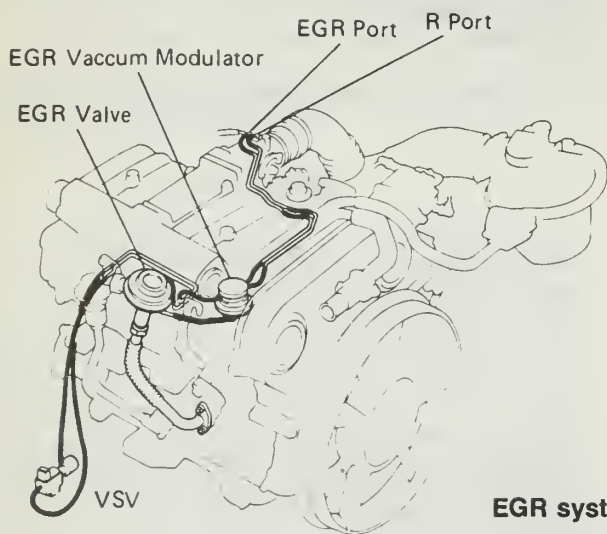
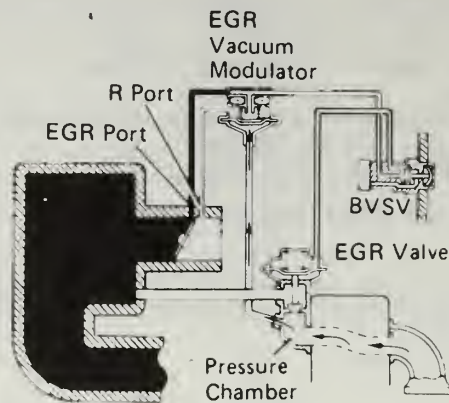


EGR system — 22R

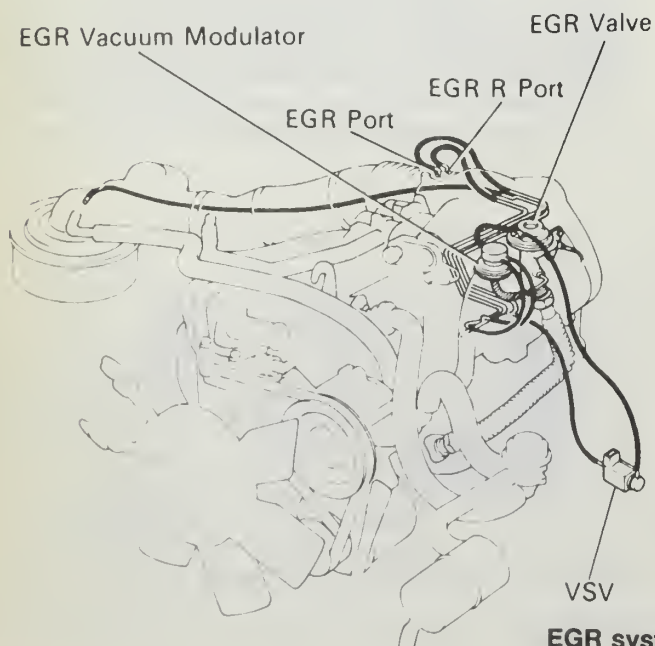
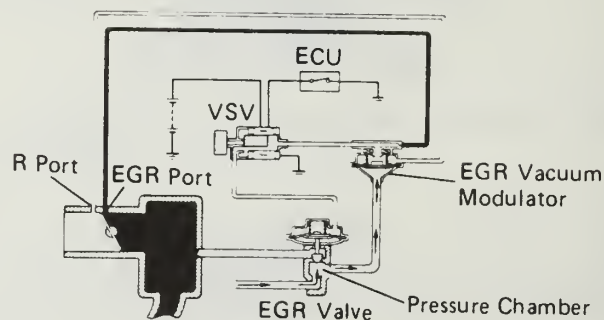
4 EMISSION CONTROLS



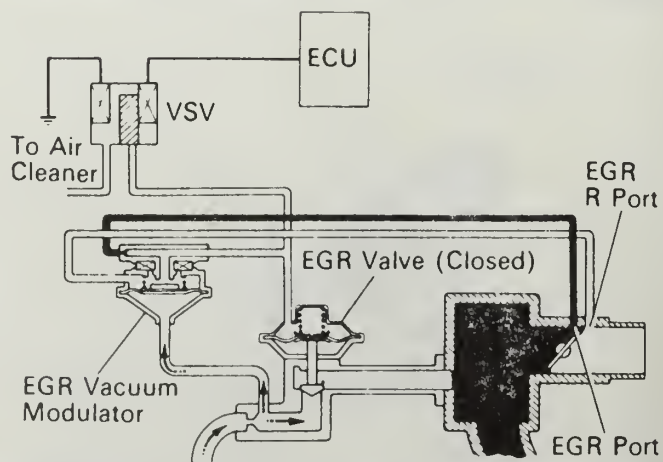
EGR system – 22R-E



EGR system – 3VZ-E



EGR system – 3F-E



driving. A binding EGR valve (either open or closed) can cause stalling, missing or reduced fuel economy.

SERVICE

EGR Valve Check

1. Start the engine.
2. Disconnect the vacuum hose leading from the EGR valve.
3. Disconnect the hose coming from the intake manifold and connect it to the empty pipe on the EGR valve.
4. When applying vacuum directly to the EGR valve, the engine should stall or stumble heavily as the valve functions. If the EGR valve does not open, it must be replaced.

EGR BVS

22R and 22R-E

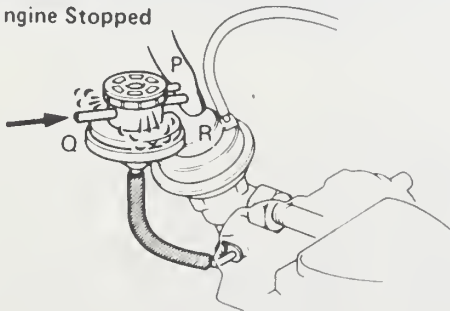
1. Drain the engine coolant and remove the BVS.

CAUTION

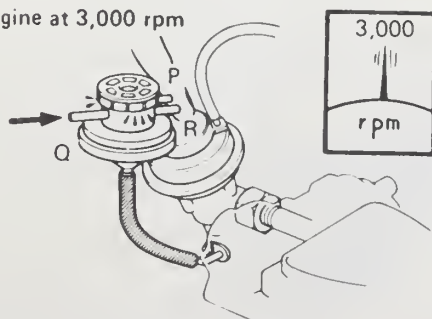
When draining the coolant, keep in mind that cats and dogs are attracted by the ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old.

2. Place the end of the BVS in cool water and blow into the bottom port.. The air should flow out the top of the valve.
3. Heat the water to a temperature above 111°F (44°C) for the 22R-E, 151°F (66°C) for the 22R-Federal and Canada, or 147°F (64°C) for the 22R Calif. and again blow into the bottom port. This time, the air should come out the upper port but not out the top of the valve.
4. If the valve is not operating properly, it requires replacement.
5. Apply liquid sealer to the threads and reinstall the BVS, tightening it to 18 ft. lbs. (25 Nm).
6. Refill the engine with coolant.

Engine Stopped



Engine at 3,000 rpm



Testing the EGR vacuum modulator with the engine off (upper) and running

Testing the EGR Vacuum Modulator

1. With the engine OFF, disconnect the 3 upper, small hoses from the EGR vacuum modulator.
2. Plug ports P and R (both on same side) with your fingers. Blow into port Q (the single one).
3. Air should flow freely to the air filter side.
4. Start the engine and maintain engine speed at 3000 rpm. (2500 rpm for 3F-E).
5. Repeat the test in Step 2; there should now be a strong resistance to air flow through the valve.
6. reconnect the vacuum hoses to the proper locations.

DASHPOT SYSTEM

Found on all 1989-90 engines except 22R, the dashpot system is used to mechanically keep the throttle open a little wider than at idle during periods of rapid deceleration. Under normal conditions, a sudden closing of the throttle plate cuts off the air more quickly than the fuel supply is reduced. This causes the engine to run momentarily very rich (proportionally too much fuel for the amount of air present) and HC emissions skyrocket. To reduce the HC and CO emissions during this period, the throttle plate is kept above idle for a short period of time, allowing more air to enter the engine. To check the dashpot operation:

1. Warm up the engine to normal temperature.
2. Check the idle speed, adjusting it if necessary.
3. On 3F-E, disconnect the ISC connector.
4. Remove the cap, filter and separator from the dashpot.
5. Run the engine at 2500 rpm for several seconds. Plug the VTV hole inside the dashpot with a finger.
6. Release the throttle. Check the engine speed while the VTV is plugged. Correct speeds are: 3F-E, 1200 rpm; 22R-E, 2000 rpm and 3VZ-E, 2000 rpm.
7. If engine speed is not correct, loosen the locknut on the dashpot shaft and adjust the shaft inward or outward as necessary to achieve the correct engine speed. Retighten the locknut.
8. Repeat the test procedure after the speed is correctly set.
9. Release the plugged VTV hole. The engine should return to curb idle in approximately 1 second.
10. Reinstall the filter, separator and cap.

Mixture Control System (MC)

OPERATION

22R Only

The mixture control system is used on carbureted models in order to reduce HC and CO emissions under sudden deceleration. When the throttle is suddenly closed, the vacuum created opens the valve and allows fresh air to pass into the intake manifold.

TESTING

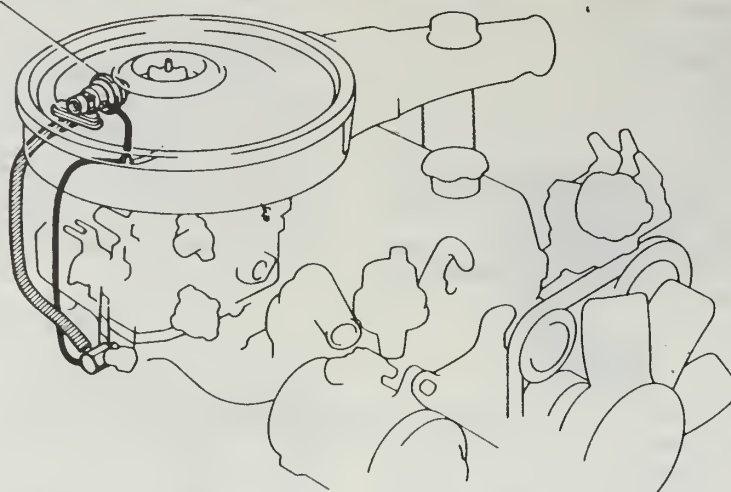
1. Start the engine.
2. Disconnect the vacuum sensing hose (top) from the MC valve.
3. Place your hand over the air inlet of the valve and check that no suction can be felt.
4. Reconnect the vacuum sensing hose. Suction should be felt momentarily.

NOTE: At this time the engine will idle roughly or stall out altogether. This is normal.

5. If the valve is not operating properly it will require replacement.

4 EMISSION CONTROLS

MC Valve

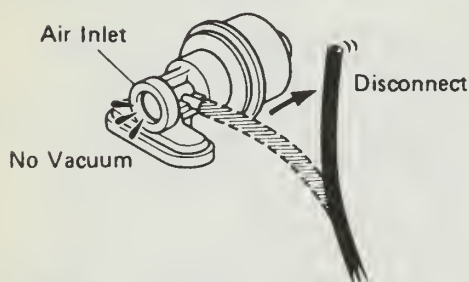


Mixture control valve and vacuum system – 22R

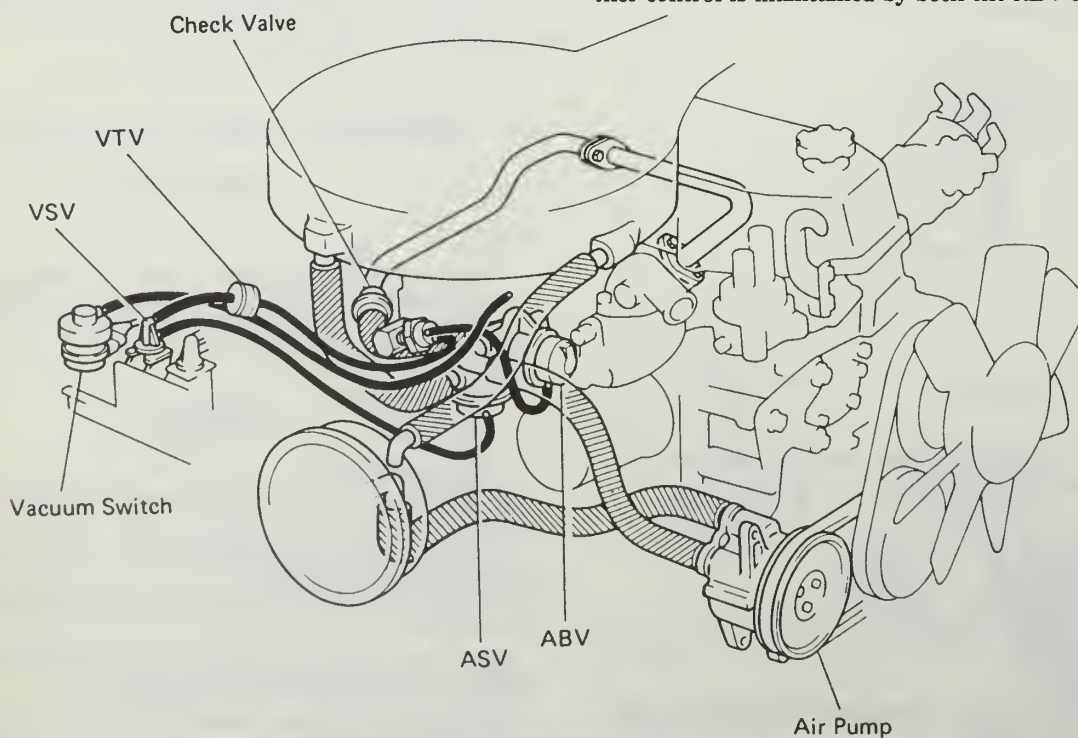
Air Injection System

OPERATION

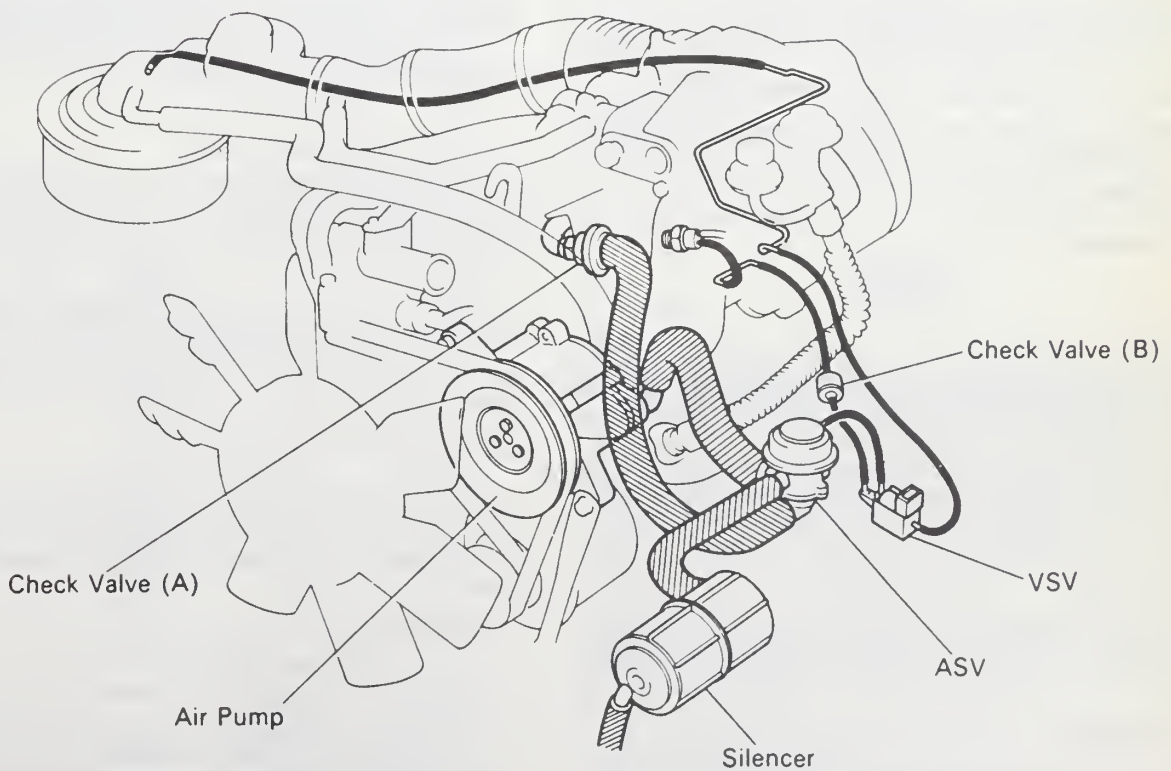
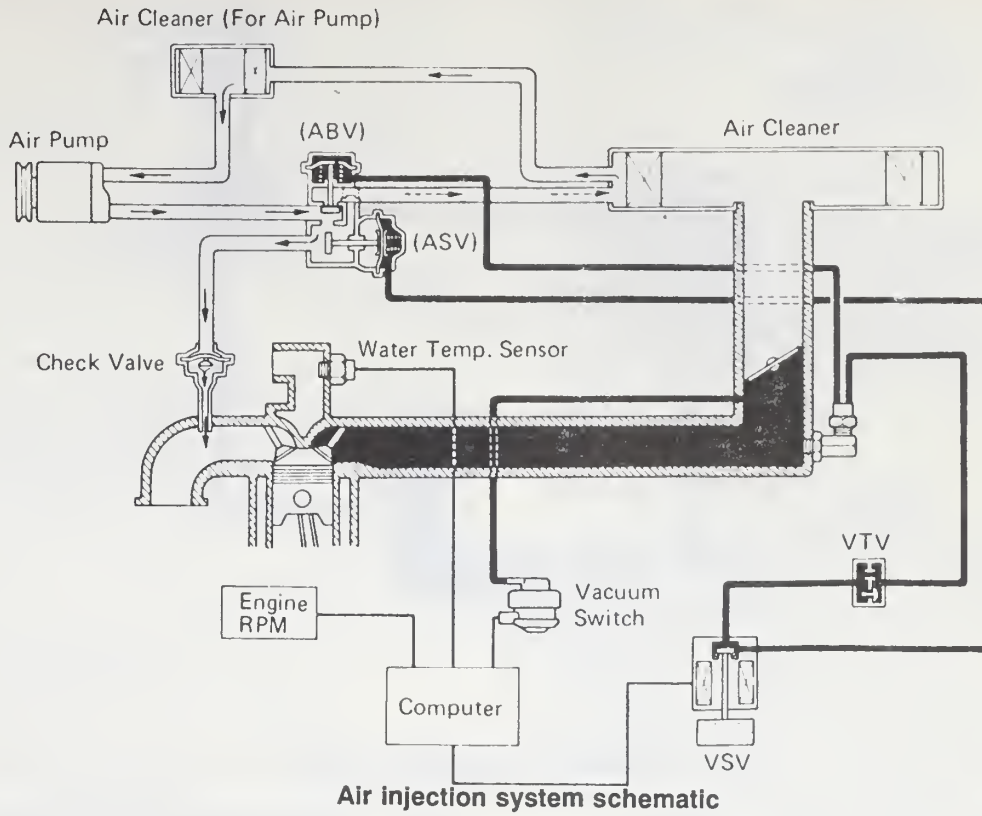
Some unburned HC and CO remains in the exhaust flow after it leaves the cylinder. To encourage further burning in the exhaust port, compressed air from the air pump (on 22R and 3F-E only) is blown into the exhaust port. This generally takes place during low and medium speed driving or during high speed deceleration. The engine control computer uses input signals from the rpm sensor, the coolant temperature sensor and the engine vacuum sensor to control the function of the vacuum solenoid valve (VSV). The VSV acts as a gatekeeper for the system, turning it on and off by controlling vacuum. Within the system, further control is maintained by both the ABV and ASV valves.



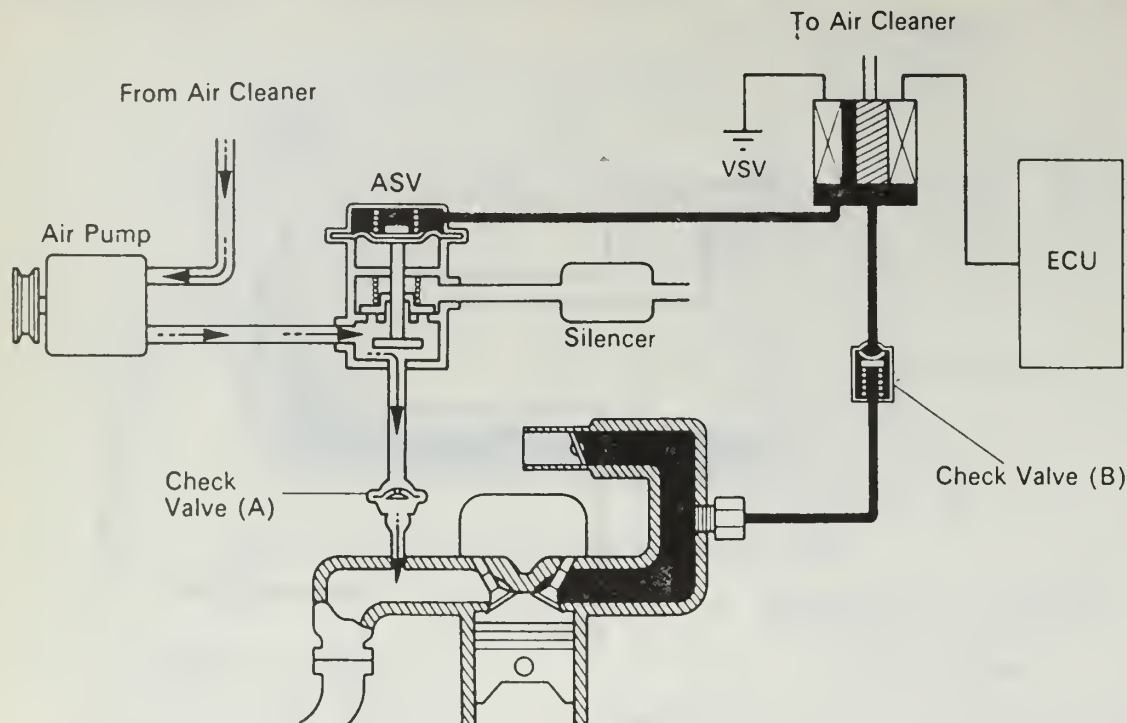
Testing the mixture control valve



Air Injection system components – 22R



4 EMISSION CONTROLS



Air Injection system schematic — 3F-E

REMOVAL AND INSTALLATION

Air Pump

1. Disconnect the air hoses from the pump.
2. Loosen the bolt on the adjusting link and remove the drive belt.
3. Remove the mounting bolts and withdraw the pump.

NOTE: Do not pry on the pump housing, it may become distorted.

4. Installation is the reverse of removal. Adjust the drive belt tension after installation. Belt deflection should be $\frac{1}{2}$ – $\frac{3}{4}$ in. with 22 lbs. pressure.

TESTING

Air Pump

NOTE: Do not hammer, pry, or bend the pump housing while tightening the drive belt or testing the pump.

BELT TENSION AND AIR LEAKS

1. Before proceeding with the tests, check the pump drive belt tension to ensure that it is within specifications.
2. Turn the pump by hand. If it has seized, the belt will slip, making a noise. Disregard any chirping, squealing, or rolling sounds from inside the pump; these are normal when it is turned by hand.
3. Check the hoses and connections for leaks. Hissing or a blast of air is indicative of a leak. Soapy water, applied lightly around the area in question, is a good method for detecting leaks.

AIR OUTPUT

1. Disconnect the air supply hose at the anti-backfire valve.
2. Connect a vacuum gauge, using a suitable adaptor, to the air supply hose.

NOTE: If there are two hoses, plug the second one.

3. With the engine at normal operating temperature, increase the idle speed and watch the vacuum gauge.

4. The air flow from the pump should be steady and fall between 2 and 6 psi. If it is unsteady or falls below this, the pump is defective and must be replaced.

PUMP NOISE DIAGNOSIS

The air pump is normally noisy; as engine speed increases, the noise of the pump will rise in pitch. The rolling sound the pump bearing make is normal. But if this sound becomes excessive at certain speeds, the pump is defective and will have to be replaced.

A continual hissing sound from the air pump pressure relief valve at idle, indicates a defective valve. Replace the relief valve.

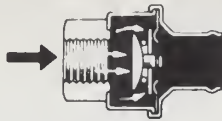
If the pump rear bearing fails, a continual knocking sound will be heard. Since the rear bearing is not separately replaceable, the pump will have to be replaced as an assembly.

Anti-backfire Valve (ABV) Test

The ABV is easily checked with the engine running at idle. Disconnect the small vacuum hose from the valve, then reconnect it. At the time of reconnection, check the end of the large output hose; a momentary burst of compressed air from the pump should be felt.

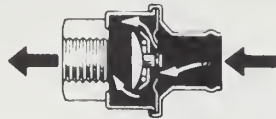
Check Valve Test

1. Remove the check valve.
2. Blow into the manifold side (large side) and check that the valve is closed.
3. Blow into the ASV side (small side) and check that the valve is open.
4. If the valve is not operating properly it requires replacement.



A1 MANIFOLD SIDE

ASV SIDE



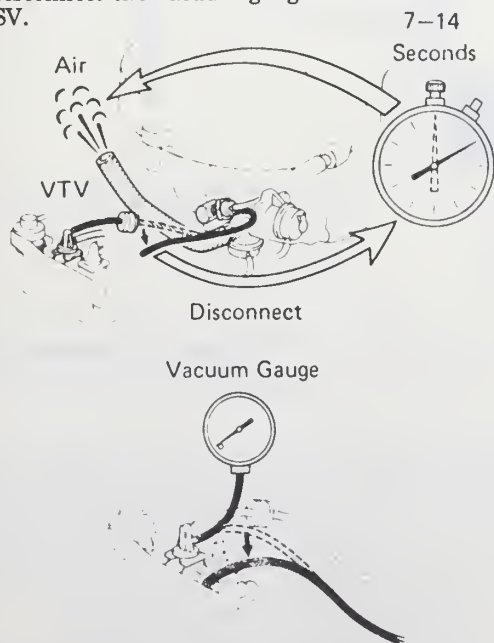
The check valve is easily tested once removed

Air Switching Valve (ASV) Tests

1. Disconnect the air bypass hose from the air cleaner.
2. With the engine coolant cold — below 43°F (6°C), start the engine and check that air is discharged from the bypass hose.
3. Warm up the engine to normal operating temperature. Plug the hose. Reconnect the vacuum line.
4. With the engine idling, check that no air comes out of the bypass hose.
5. Race the engine momentarily and quickly release the throttle; air should be momentarily discharged from the bypass hose.
6. Increase the engine speed to a steady 3000 rpm; air should be discharged through the hose.
7. Reconnect the air hose to the air cleaner.

Vacuum Switching Valve Test

1. Disconnect the hose between the VSV and the ASV at the VSV side.
2. Connect a vacuum gauge to the VSV port.
3. Run the engine at 4800 rpm; the gauge should read zero.
4. Pinch the hose between the vacuum switch and the air pipe.
5. Again increase engine speed to 4800 rpm; the gauge should indicate manifold vacuum.
6. Disconnect the vacuum gauge and reconnect the hose to the VSV.



To check the VSV, connect the vacuum gauge. Vacuum should only be present at 4800 rpm with the hose pinched

High Altitude Compensation (HAC) System

OPERATION

Carbureted Models Only

At high altitudes, air/fuel mixtures become richer, due to the thinner air available. The High Altitude Compensation (HAC) system installed on trucks sold in federally designated areas insures a proper air/fuel mix by supplying additional air to the low and/or high speed circuits at high altitude (above 4000 feet) to minimize HC and CO emissions. The system also advances the ignition timing to improve driveability at high altitudes.

The HAC system consists of an HAC valve, a dual diaphragm distributor, and a check valve.

HIGH ALTITUDE OPERATION

Low atmospheric pressure allows the bellows in the HAC valve to expand and close port A. Intake manifold vacuum acts on the diaphragm in the HAC valve through the check valve, opening the passages between the carburetor and the atmosphere via the HAC valve. These open passages allow air to flow into the low and/or high speed circuits in the carburetor. As a result, the air/fuel mixture becomes leaner.

The intake manifold vacuum also acts on the sub-diaphragm in the distributor. This vacuum is maintained by the check valve, except in the following instance: a vacuum in the main diaphragm of the distributor rises above 127mm of mercury (Hg), the vacuum advance will revert to normal.

LOW ALTITUDE OPERATION

High atmospheric pressure, entering through the bottom of the HAC valve acts on the bellows and opens port A. Since the intake manifold vacuum does not act on the diaphragm in the HAC valve, the air passage from the carburetor to the atmosphere is closed by the diaphragm. This prevents a lean mixture at lower altitudes.

The intake manifold vacuum also cannot act on the distributor sub-diaphragm, so the distributor advance is normal.

TESTING

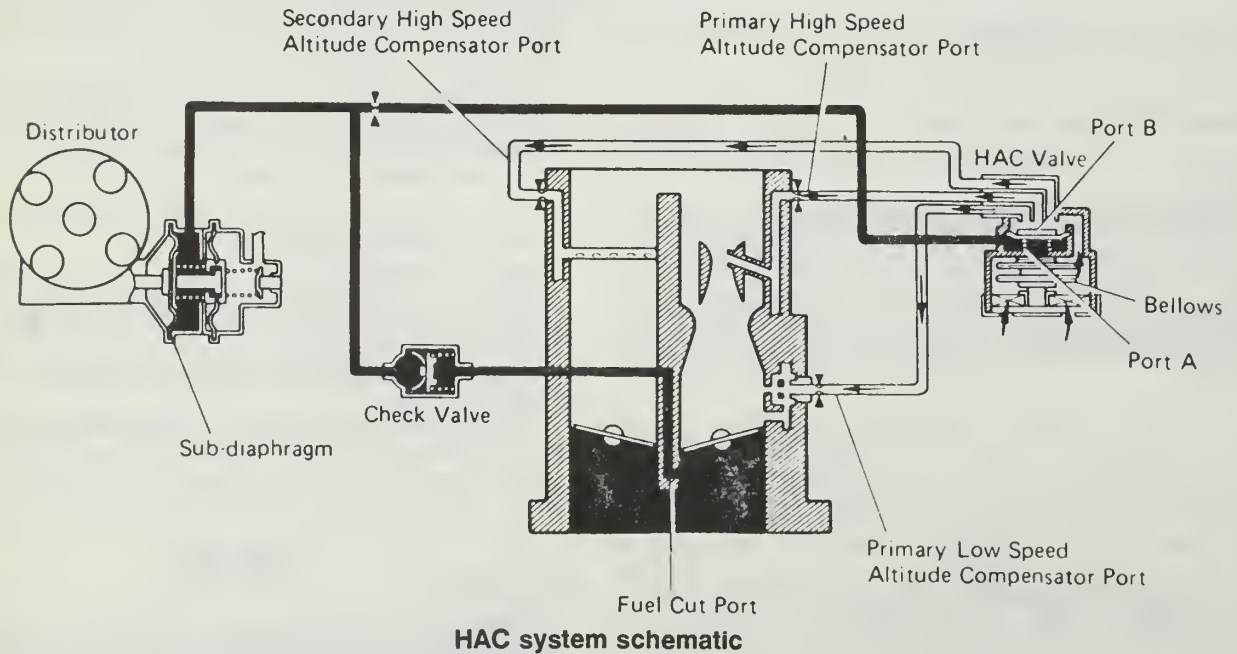
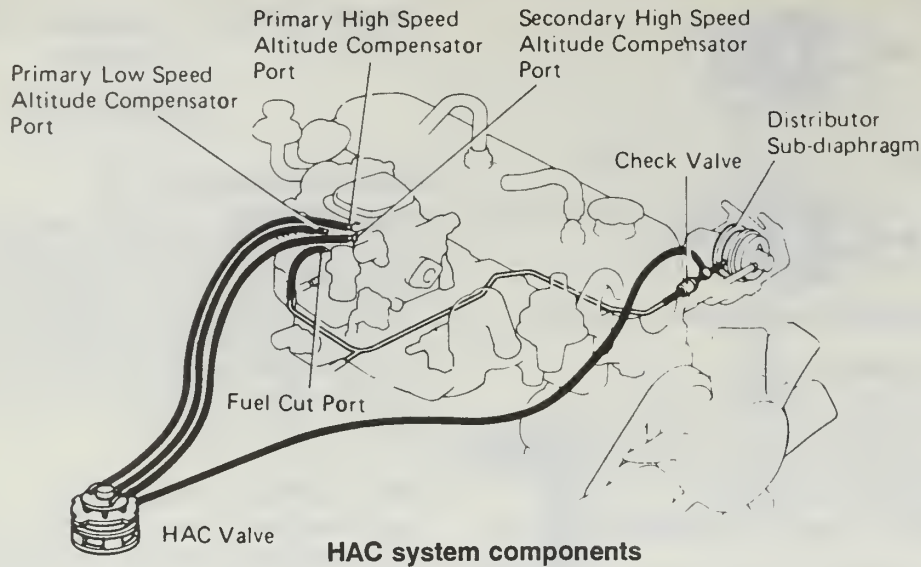
Inspection

NOTE: Before checking the HAC system at altitudes near 4000 feet, determine the position of the HAC valve. This can be done by blowing into any one of the three ports on top of the HAC valve when the engine is idling. If the passage is open, the valve is in the high altitude position. If it is closed, the valve is in the low altitude position. When the position is determined, proceed with the appropriate high altitude or low altitude inspection.

INSPECTION AT HIGH ALTITUDE

1. Check all vacuum hoses for leaks, breaks, kinks, or improper connections.
2. Visually inspect the HAC filter and replace it if clogged. It is located at the bottom of the HAC valve.
3. Disconnect the hoses from the distributor diaphragms and plug the end of each hose.
4. Start the engine and check the ignition timing. It should be 0 degrees (TDC).

4 EMISSION CONTROLS



5. Reconnect the hoses to the diaphragms while the engine is running. Recheck the timing; it should now be 12° BTDC.

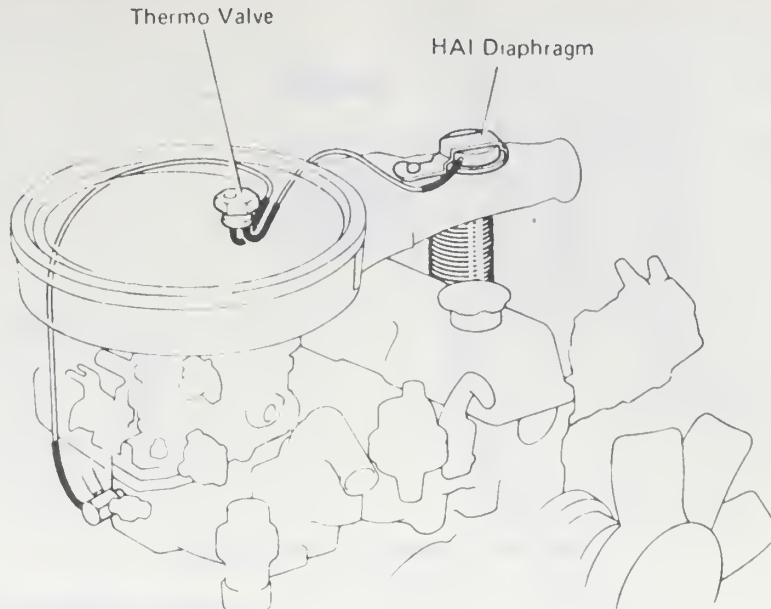
INSPECTION AT LOW ALTITUDE

1. Check all hoses for leaks, breaks, kinks, and improper connections.
2. Inspect the HAC filter, located in the bottom of the HAC valve, and replace it if clogged.
3. Start the engine and disconnect the two HAC hoses from the carburetor.
4. If air is blown into each hose, it should not flow into the HAC valve. If it does, replace the valve.
5. Reconnect the two hoses. Check the ignition timing. If the timing is correct, the HAC system is okay. It should be 12° BTDC at 950 rpm.

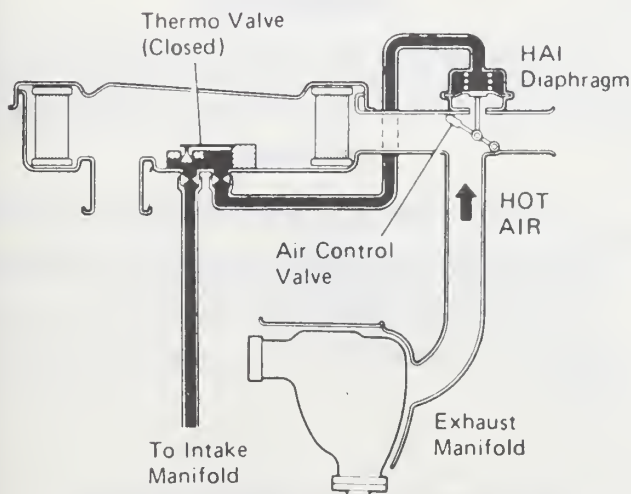
Automatic Hot Air Intake System (HAI) OPERATION

22R

This system allows hot air from around the exhaust manifold to be routed to the carburetor in cold weather. Instead of cold air being sucked into the air cleaner all the time, a thermo-valve in the air cleaner housing closes when the temperature inside the air cleaner falls below a certain point. When the thermo valve is closed, a diaphragm on the air cleaner neck is activated and it opens the air control valve. This not only prevents cold outside air from entering the air cleaner, but allows the hotter air from around the exhaust manifold to flow in. This system improves driveability by maintaining a constant air intake temperature, resulting in more stable fuel atomization. It also serves to prevent carburetor icing in cold and moist weather.



Hot air Intake system, 22R



Below 86°F (30°C), the system inducts air from around the exhaust manifold

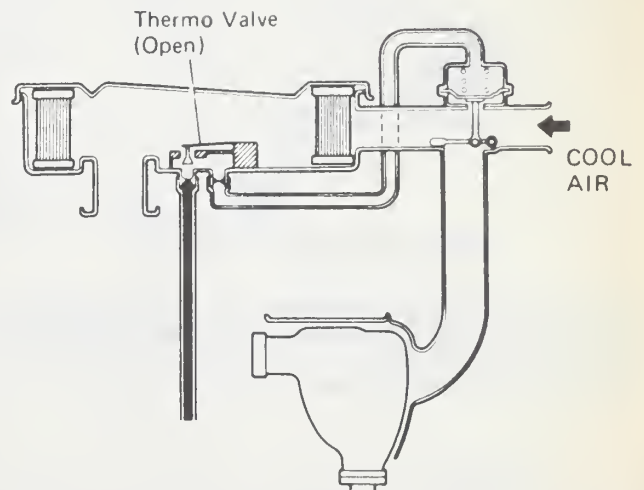
TESTING

1. Visually inspect all hoses and connections for cracks, leaks or other damage.
2. Remove the air cleaner top.
3. Cool the thermo valve by blowing compressed air on it.
4. With the engine idling and the thermo valve closed (cool), check to see if the air control valve in the neck of the air cleaner is open and allowing hot air to enter the air cleaner.
5. Install the top of the air cleaner and run the engine until it reaches normal operating temperature.
6. Check that the air control valve is now closed and only cool air is being allowed to enter the air cleaner.

Automatic Choke System OPERATION

22R

The purpose of the any choke is to temporarily richen the



Once the temperature within the air cleaner exceeds 113°F (45°C), the air door opens to allow outside air into the air cleaner

air/fuel mixture to the engine by closing the choke valve when the engine is cold. By shutting the choke valve, air entering the engine is restricted, yielding a richer mixture. This then enables the air/fuel mixture to be ignited sooner. While this makes the engine easier to start and drive when cold, it also sends emission levels off the scale.

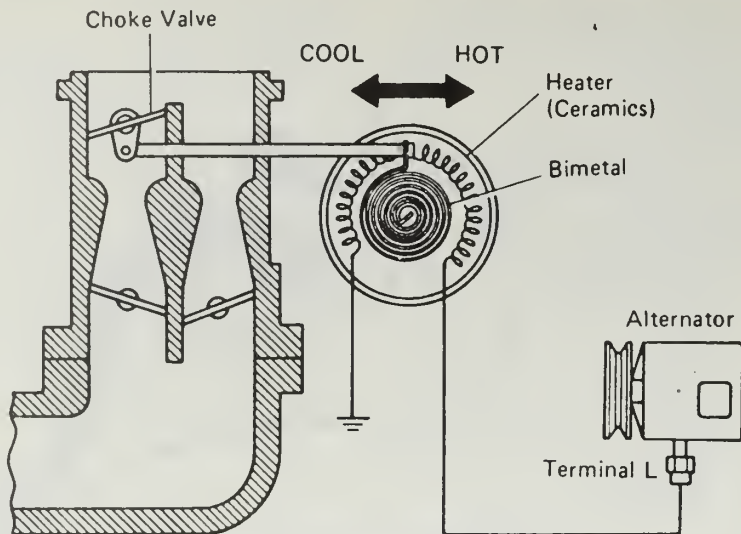
For emission reasons, choke operation is closely monitored by several related systems. The intent is first, to provide just enough choke only as long as necessary for correct operation and second, to remove (open) the choke as soon as possible to reduce emissions.

The 22R carburetor uses an electrically heated ceramic choke heater. As the resistance builds heat in the bi-metal coil, it expands, pulling on the lever and opening the choke. Conversely, as the engine cools, the choke automatically resets for the next cold start sequence. This self-resetting feature eliminates the need to index the choke and bi-metal coil.

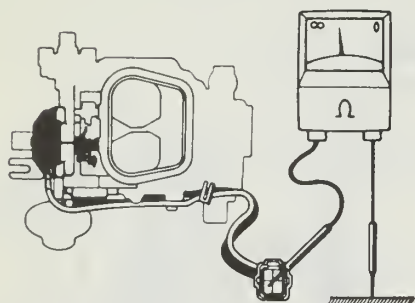
TESTING

1. Unplug the wiring connector for the choke heater.

4 EMISSION CONTROLS



Automatic choke and heater system



Testing the heater resistance

2. Measure resistance of the heater coil. Correct resistance is 19–23 Ω at 68°F (20°C). Resistance will vary with temperature of the coil use good judgment when testing.
3. Reconnect the wire harness.

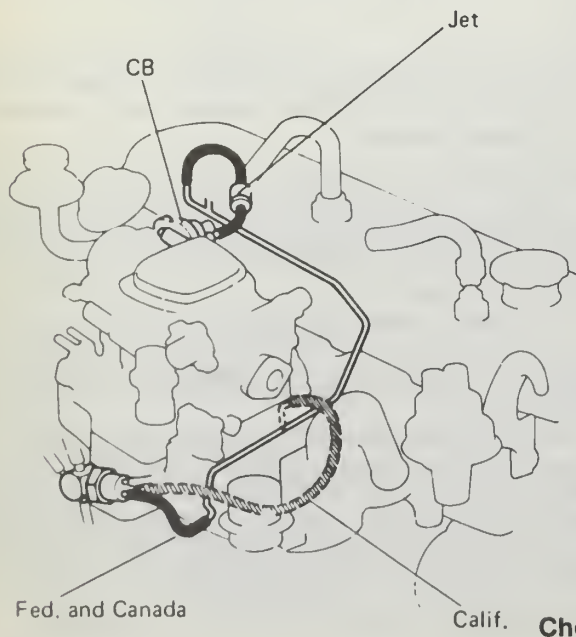
Choke Breaker System (CB)

OPERATION

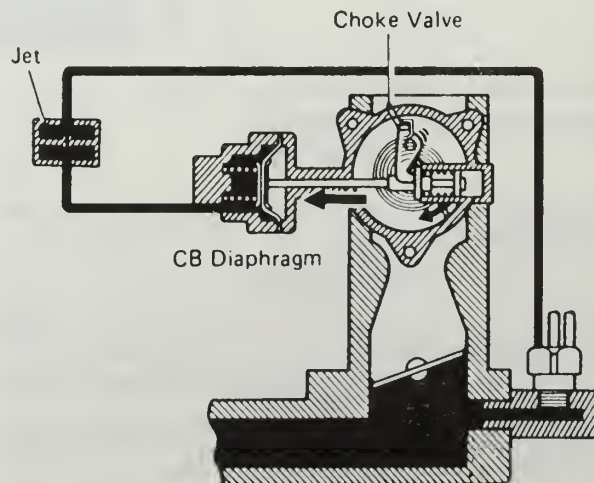
The choke breaker system is used to monitor the automatic choke system. To prevent too rich a mixture when the choke is closed, the choke breaker forces the choke valve open slightly.

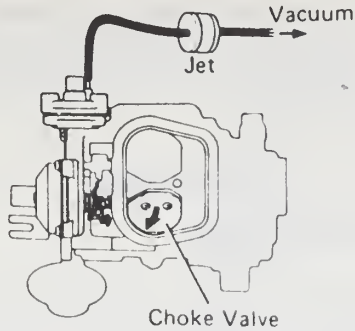
TESTING

1. Check the choke linkage and diaphragm with the engine cold.
2. Hold the throttle slightly open; push the choke plate closed and hold it closed as you release the throttle.
3. Disconnect the hose between the jet and the vacuum source.
4. Apply vacuum to the jet. The choke plate should open slightly.



Choke breaker system





Set the choke before applying vacuum to the breaker

5. Reconnect the vacuum hose to the vacuum source.

Deceleration Fuel Cut System

This system cuts off part of the fuel in the slow circuit of the

carburetor to prevent overheating and afterburning of the exhaust system. To check the operation of the system:

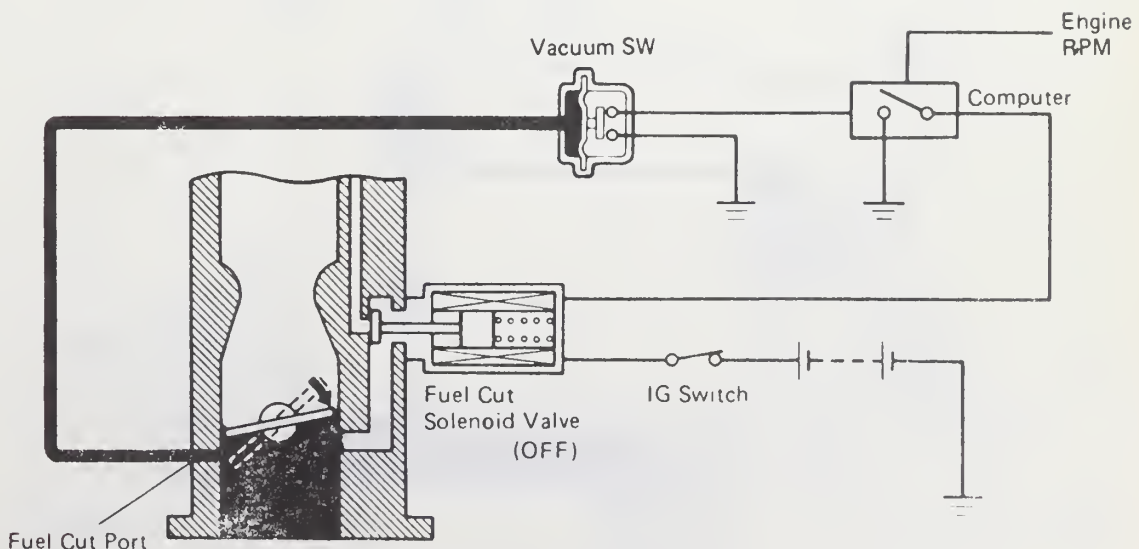
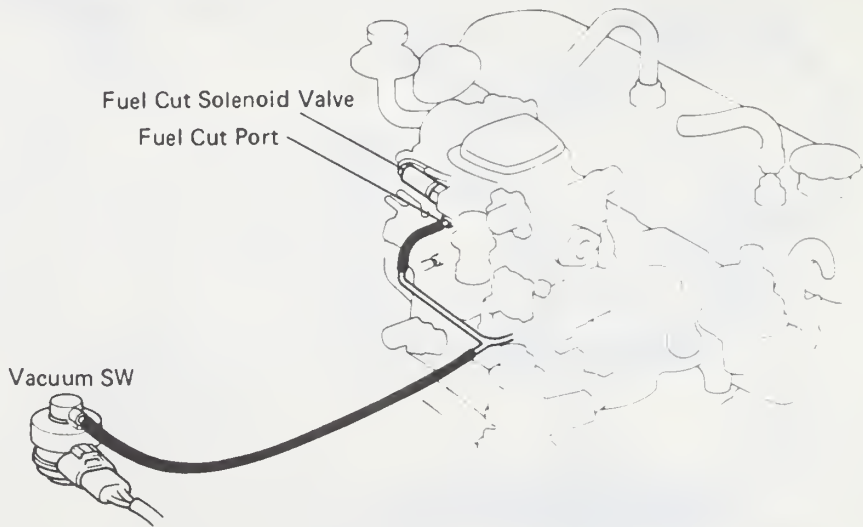
1. Connect a tachometer to the engine.
2. Start the engine and check that it runs normally.

NOTE: If the vehicle is equipped with High Altitude Compensation (HAC), disconnect the vacuum hose from the lower port of the HAC valve. Plug the hose.

3. Pinch the vacuum hose to the vacuum switch.
4. Gradually increase the engine speed to 3000 rpm. Check that the engine misfires slightly between 2400 and 3000 rpm.

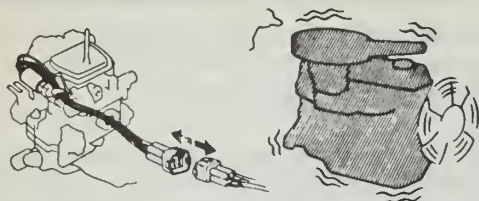
WARNING: Perform this procedure quickly to avoid overheating the catalytic converter.

5. Release the hose and gradually increase the engine speed to 3000 rpm. Check that the engine operation is normal.
6. With the engine at idle unplug the solenoid valve. Check that the engine misfires or stalls.
7. Stop the engine and reconnect the wiring. Remove the tachometer.



Deceleration fuel cut system

4 EMISSION CONTROLS



With the solenoid disconnected, the engine should run rough or die

Air Suction System OPERATION

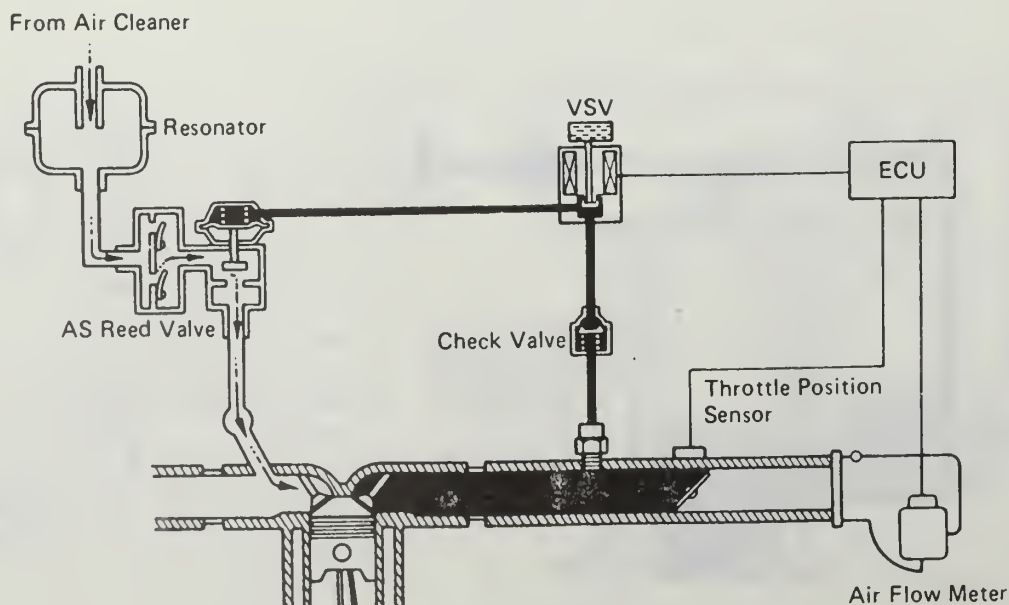
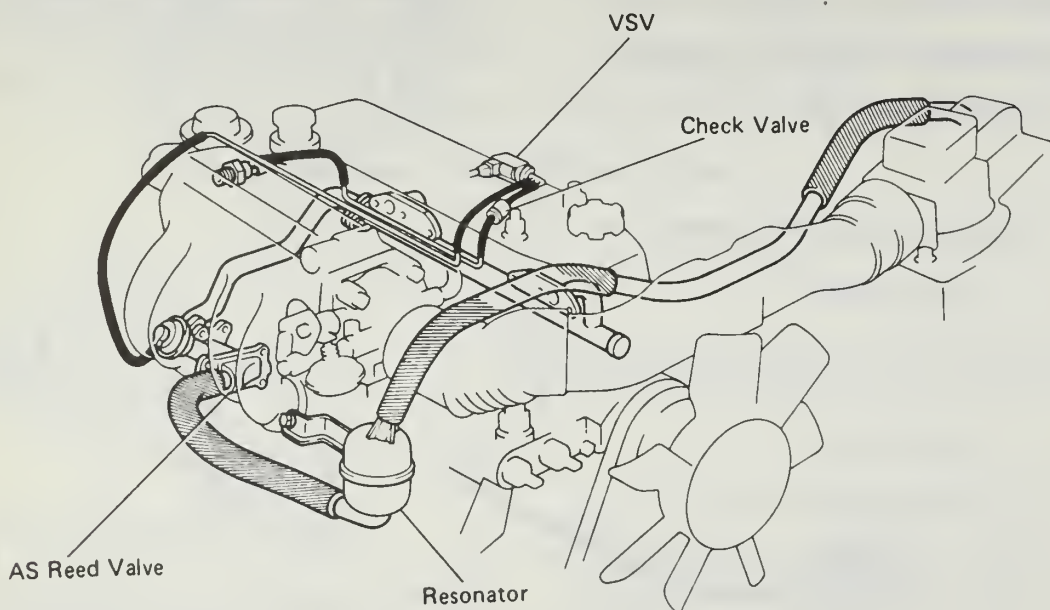
This system is used to introduce extra fresh air into the ex-

haust ports to accelerate oxidation and after-burn of exhaust gases. This helps reduce HC and CO emissions. The system uses vacuum generated by the exhaust pulses in the manifold to control the entry of fresh air into the system. Only the 3F-E engine does not use Air Suction.

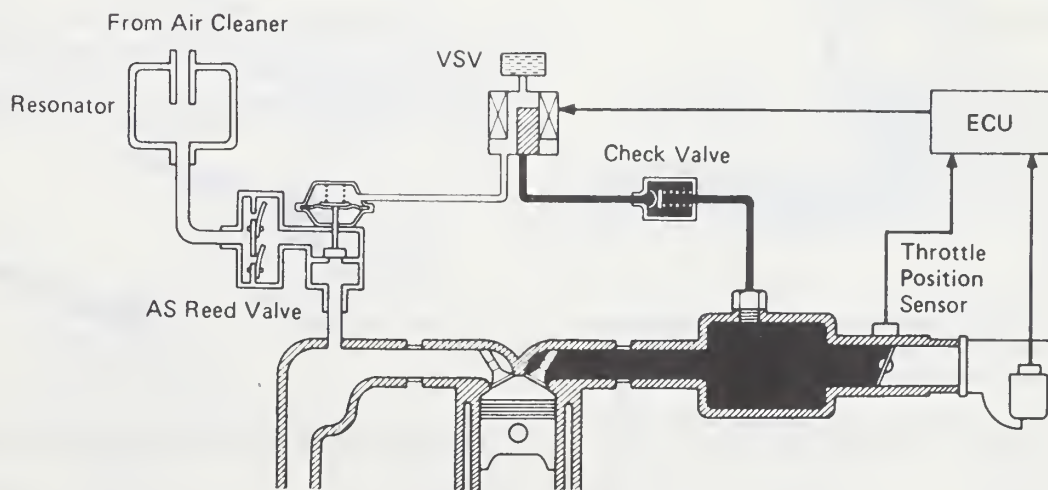
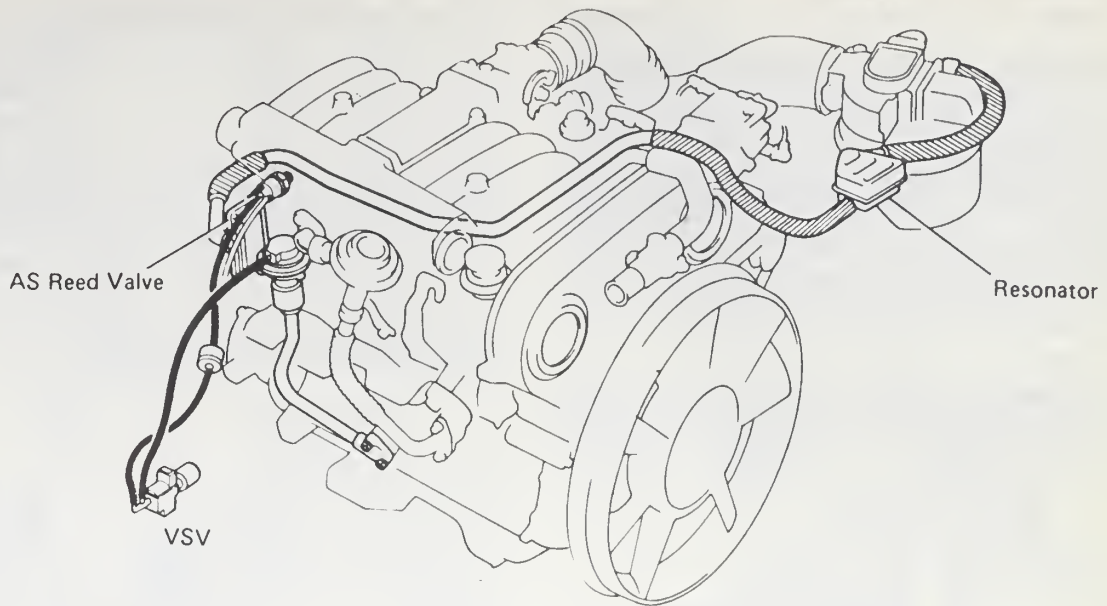
TESTING

22R-E and 3VZ-E Engines

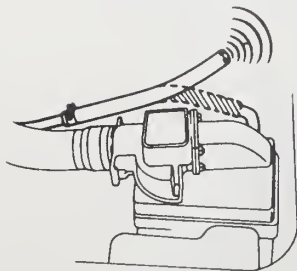
NOTE: These two engines use a similar system although component placement and hose routing are different. Refer to the illustrations for exact location of components and hoses.



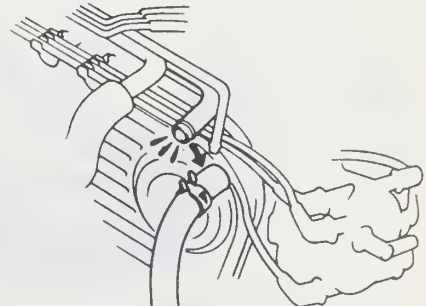
Air suction system — 22R-E



Air suction system – 3VZ-E



No.1 air suction hose – 22R-E



No. 2 air suction hose – 3VZ-E

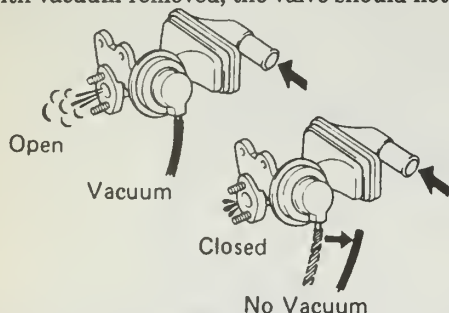
4 EMISSION CONTROLS

SYSTEM TEST

1. With the engine cold, but running at idle, disconnect the No. N (22R-E) or No. 2 (3VZ-E) air suction hose from the air cleaner.
2. A bubbling or gurgling noise should be heard from the hose (22R-E) or pipe (3VZ-E).
3. Warm the engine to normal operating temperature.
4. Again listen for the noise; it should not be heard with the engine warm.
5. Race the engine above 2000 rpm.
6. On 3VZ-E, the noise should reappear within 2-6 seconds.
7. On 22R-E, quickly close the throttle from 2000 rpm. The noise heard in the hose should stop momentarily.

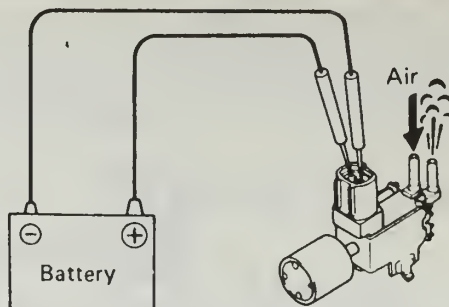
REED VALVE

The reed valve should be checked with vacuum applied to the diaphragm. With vacuum applied, air should pass through the valve. With vacuum removed, the valve should not conduct air.

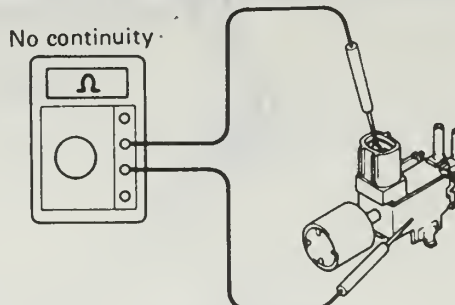


Testing the reed valve. 22R-E shown, 3VZ-E similar VACUUM SOLENOID VALVE (VSV)

1. Perform these tests with the ignition OFF. Disconnect the wiring connector and vacuum hoses from the VSV.
2. Use jumper wires to connect the terminals of the valve to the battery terminals.
3. Blow into the port closest to the body of the valve. Air should come out the other port.
4. Disconnect the jumpers from the battery. Again blow into the port nearest the body of the valve; air should not come out the other port and should come out of the air filter on the side of the valve.
5. Use an ohmmeter to check for a short in the valve. Place one probe against the body of the valve and check each terminal.

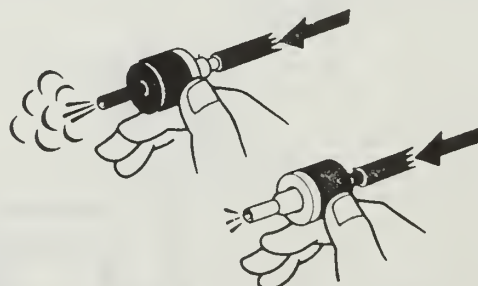


Air should pass with 12v. applied to the air suction VSV. 3VZ-E shown, 22R-E similar

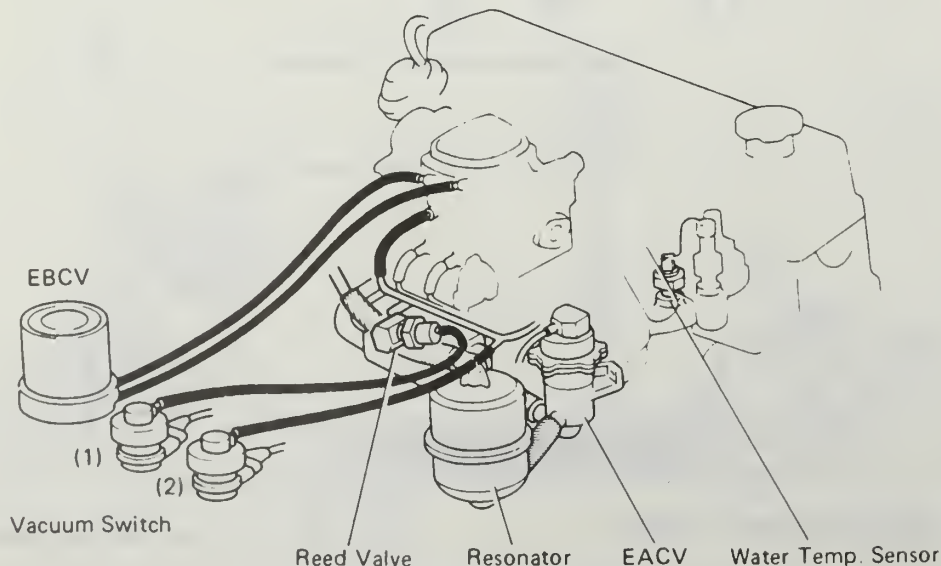


Checking the VSV for internal short
for continuity. No continuity should exist between either terminal and the body of the valve.

6. Measure resistance across the pins of the terminal. With the valve at 68°F (20°C), resistance should be 30-50Ω. Resis-



Any check valve can be tested for one-way flow



Component location and system layout for 22R air suction system

7. Reinstall the valve if it was removed. Connect the hoses and wire harness.

The check valve is a simple one-way valve to prevent vacuum loss within the system. The colored side is always the input side, so blowing into the colored side will allow air to pass. Blow (gently) into the black side; no air should pass. If the valve was removed for testing, make certain it is reinstalled correctly.

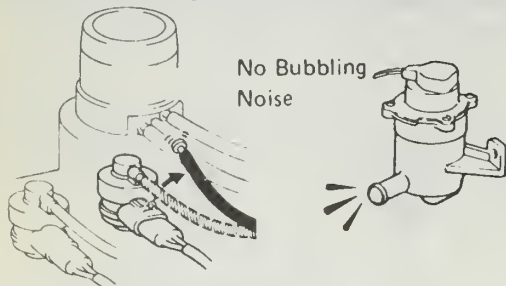
The air suction system used on this engine is integrally tied to and controlled by the engine computer. Based on signals from the oxygen sensor in the exhaust, this feedback system is used to constantly adjust the amount of air entering the exhaust. The engine computer receives many inputs regarding engine and exhaust conditions; at the appropriate time, the computer signals the electronic air control valve (EACV) and the electronic air bleed control valve (EBCV) into operation, allowing air to enter the exhaust manifold.



4 EMISSION CONTROLS

AIR SUCTION SYSTEM TEST

1. Visually inspect the system components for kinked or damaged hoses, loose connections, etc.
2. Disconnect the air supply hose from the EACV.
3. With the engine cold and running at idle, check that no noise is heard from the EACV.
4. Warm the engine to a partially-warm condition. At 64–111°F (18–44°C), and hold the engine speed above 1400 rpm.
5. Warm the engine to normal operating temperature. Above 131°F (55°C), a bubbling noise should be heard intermittently



Checking 22R EACV with the vacuum hose disconnected

- from the EACV with the engine running above 1400 rpm.
6. Allow the engine to return to idle. Below 1000 rpm, the bubbling noise should be heard constantly.
 7. With the engine warmed up, disconnect the vacuum hose from the No. 2 vacuum switch and plug the hose end.
 8. No bubbling should be heard from the EACV.
 9. Reconnect all hoses to the correct location.

FUEL FEEDBACK CONTROL SYSTEM TEST

1. Hold the engine speed at 2000 rpm.
2. Disconnect the wiring connectors to the EACV and EBCV.
3. Wait a few seconds, then reconnect the EBCV connector. Check that the engine speed drops about 300 rpm.
4. Disconnect the vacuum hose from the No. 2 vacuum switch. Plug the hose end. After a few seconds, the engine speed should return to 2000 rpm.
5. Reconnect the vacuum hose and wiring connectors.
6. If no problem was found, the system is operating correctly.

EACV

1. With the engine running at idle, disconnect the air suction hose from the EACV.
2. Disconnect the connector from the water temperature sensor.
3. No bubbling noise should be heard from the valve.
4. Use a small jumper to connect both terminals of the water temperature sensor connector.
5. Hold the engine speed above 1400 rpm. The bubbling noise should be heard intermittently from the EACV. If a problem is found, the EACV must be replaced.
6. Reconnect the wiring and vacuum hose.



Test the EACV with the temperature sensor wire jumpered

REED VALVE

Disconnect the single hose from the reed valve. Air should pass through the valve when blown strongly into it; no air should pass when sucked.

VACUUM SWITCHES

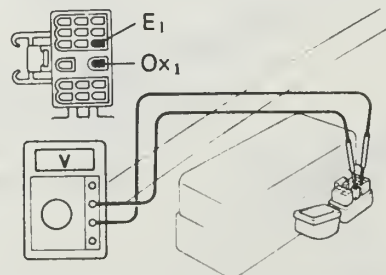
1. With the engine OFF, disconnect the wire connector from the valve.
2. Check for no continuity between the terminals of the switch. If any continuity is found, the valve is faulty.
3. Connect a vacuum pump to the vacuum port on the switch. For vacuum switch No. 1, apply vacuum above 3.54 in. Hg (90 mm Hg). For vacuum switch No. 2, apply vacuum above 16.93 in. Hg (430 mm Hg).
4. With the correct amount of vacuum applied, continuity should be present at the terminals of the valve.
5. If no continuity is found, the switch must be replaced.

EBCV

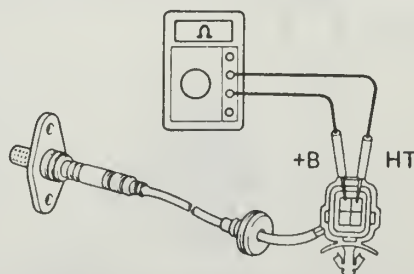
1. With the engine OFF, disconnect the electrical connector to the valve.
2. Check that there is no continuity between the positive terminal of the EBCV and the body of the unit.
3. Measure the resistance across the terminals of the connector. At 68°F (20°C), resistance should be 11–13Ω. Resistance will vary with temperature; use good judgment when interpreting test results.

OXYGEN SENSOR

1. Warm up the engine to normal operating temperature.
2. Connect a voltmeter to the check connector under the hood near the No. 2 relay block. Connect the positive probe to the OX1 terminal and the negative probe to the E1 terminal.



Correct testing hook-up for checking 22R oxygen sensor function



Use an ohmmeter to test the oxygen sensor heater

3. Hold the engine at 2500 rpm for at least 90 seconds, then check the voltmeter. The needle should fluctuate between 0 and 5 volts. The needle should fluctuate at least 6 times or more within 10 seconds.
4. If voltage test is correct, the oxygen sensor is working properly.
5. The resistance of the oxygen sensor heater can be measured, but should be done with the engine cold. It should NOT be done in conjunction with the above tests.
 - a. With the engine cold and turned OFF, disconnect the oxygen sensor connector.

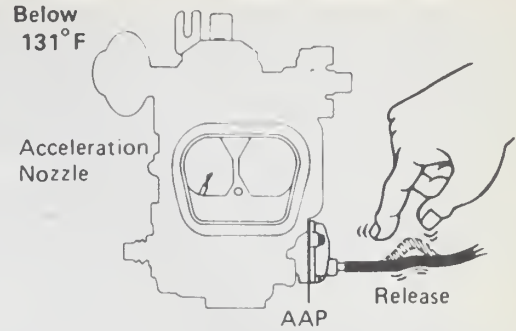
- b. Use an ohmmeter to measure the resistance between terminals B and HT.
- c. Correct resistance is $5.1-6.3\Omega$ with the temperature of the oxygen sensor at 68°F (20°C). It is for this reason that the engine (and exhaust system) must be fully cooled before testing. The slightest temperature increase at the tip of the sensor can yield incorrect test results.
- d. If resistance is not correct, the oxygen sensor must be replaced.
- e. Reconnect the sensor connector.

Auxiliary Acceleration Pump (AAP) System

OPERATION

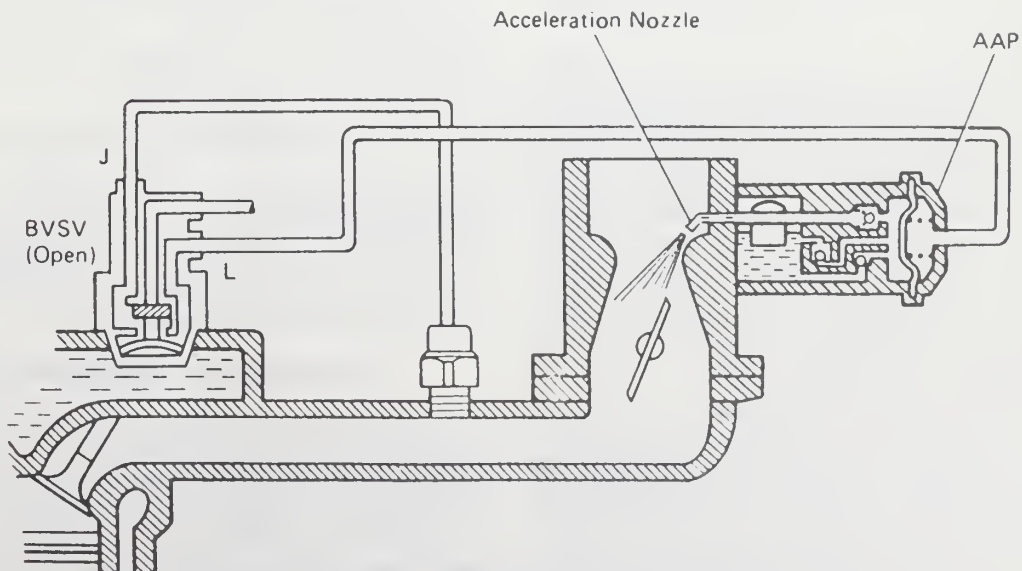
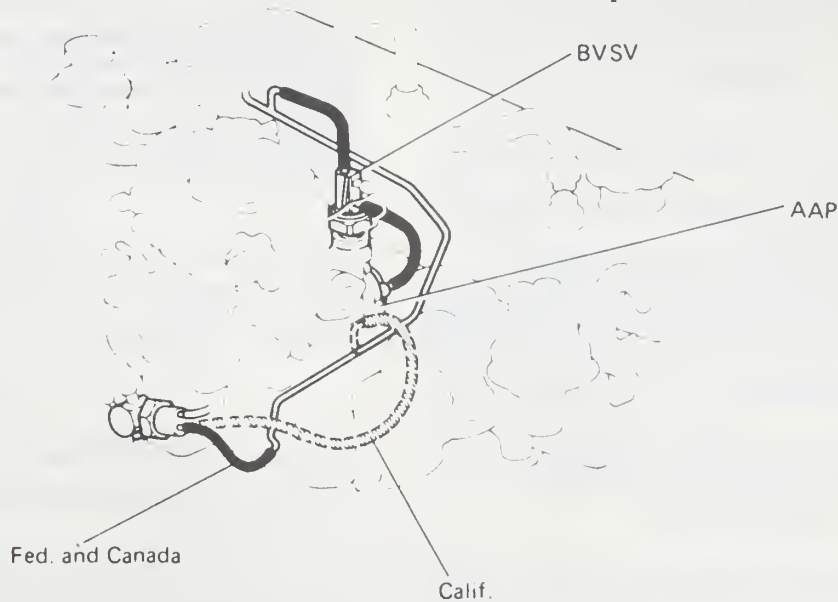
22R Engine

To reduce emissions, carburetor air/fuel mixtures are cali-



When inspecting the AAP system, check for a fuel spurt when the vacuum hose is released

brated to be as lean as possible. Although a lean mixture will burn readily at hotter temperatures, it is reluctant to ignite when cold because fuel vaporizes less readily when cold. Thus, increasing the amount of fuel in a cold air/fuel mixture increases the amount of vaporized fuel available.



Auxiliary acceleration pump components and schematic — 22R

4 EMISSION CONTROLS

The problem of a poor air/vaporized fuel mixture in a cold engine is accentuated when accelerating. Although the carburetor is equipped with an acceleration pump for the normal demands of an accelerating engine, its capacity is insufficient for a cold engine. The auxiliary acceleration pump (AAP) is designed to send additional fuel into the acceleration nozzle in the carburetor independent of the regular acceleration pump.

The AAP itself is an integral part of the carburetor. It consists of two check valves controlled by springs and a diaphragm controlled by both a spring and engine vacuum. At constant speeds, intake manifold vacuum draws the AAP diaphragm back, enlarging the chamber and allowing gasoline to enter. When the engine is accelerated, intake manifold vacuum drops, allowing the AAP diaphragm to be pushed back by the spring. The resultant reduction in chamber volume forces the gasoline out through the other check valve, into the acceleration nozzle. The engine gets a needed squirt of gasoline at just the time needed.

AAP operation is governed by the same BVSF used in the choke breaker system. At cold coolant temperatures, the BVSF allows intake manifold vacuum to reach the AAP diaphragm. At approximately 131°F (55°C), it closes off the passage to vacuum, thus shutting off the AAP function on a fully warmed engine.

SERVICE

Inspection

The vacuum hose should be checked for leaks, kinks, or improper connection.

1. With the engine cold and idling, remove the air cleaner cap and look into the carburetor.
2. Pinch the AAP hose shut and stop the engine.
3. Release the hose; check that a spurt of gas is seen from the acceleration nozzle at the instant the vacuum hose is released.
4. Fully warm the engine to normal temperature and repeat the test.
5. No gasoline should spurt from the acceleration nozzle.
6. Reinstall the air cleaner.

Oxygen Sensor System

OPERATION

The three-way catalytic converter, which is capable of reducing HC, CO and NO_x into CO₂, H₂O, O₂ and N₂ can only function as long as the air/fuel mixture is kept within a critically precise range. The oxygen sensor system is what keeps the exhaust oxygen range in control.

The oxygen sensor system works like this: As soon as the engine warms up, the computer begins to work. The oxygen sensor, located in the exhaust manifold, senses the oxygen content of the exhaust gases. The amount of oxygen in the exhaust varies according to the air/fuel mixture. The O₂ sensor produces a small voltage that varies depending on the amount of oxygen in the exhaust at the time. This voltage is picked up by the computer. The computer reads this data and directs the operation of other components to control the air/fuel mixture entering the engine. For fuel injected motors, the timing (duration) of the injectors is controlled to increase or limit the amount of fuel. On carbureted engines, where fuel control is not feasible, the feedback air suction system is controlled to limit or increase the amount of air added to the exhaust stream.

If the amount of oxygen in the exhaust system is low, which indicates a rich mixture, the sensor voltage will be high. On fuel injected engines, the higher the voltage signal sent to the computer, the more it will reduce the amount of fuel supplied to the engine. The amount of fuel is reduced until the amount of oxygen in the exhaust system increases, indicating a lean mixture. When the mixture is lean, the sensor will send a low voltage signal to the computer. The computer will then increase the quan-

tity of fuel until the sensor voltage increases again and then the cycle will start over.

It is impossible to maintain the perfect mixture for any length of time; the system is constantly swinging back and forth when the engine is running. Since the limits of the swing are relatively close, the range of rich/lean changing closely approximates the ideal range.

OXYGEN SENSOR REPLACEMENT

1. Disconnect the negative battery cable.
2. Unplug the wiring connector leading from the sensor.

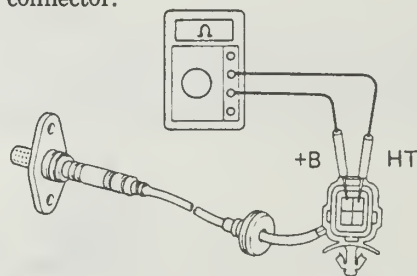
NOTE: Be careful not to bend the line; the oxygen sensor will not function properly if the lead is damaged.

3. Unscrew the two nuts and carefully pull out the sensor.
4. Installation is in the reverse order of removal. Always use a new gasket. Tighten the nuts to 13-16 ft. lbs.

TESTING THE OXYGEN SENSOR HEATER

The resistance of the oxygen sensor heater can be measured, but should be done with the engine cold. It should NOT be done in conjunction with other tests on a warm engine. To test the heater:

1. With the engine cold and turned OFF, disconnect the oxygen sensor connector.



Use an ohmmeter to test the oxygen sensor heater

2. Use an ohmmeter to measure the resistance between terminals B and HT.
3. Correct resistance is 5.1-6.3Ω with the temperature of the oxygen sensor at 68°F (20°C). It is for this reason that the engine (and exhaust system) must be fully cooled before testing. The slightest temperature increase at the tip of the sensor can yield incorrect test results.
4. If resistance is not correct, the oxygen sensor must be replaced.
5. Reconnect the sensor connector.

TESTING SENSOR FUNCTION

Procedures for testing the 22R oxygen sensor are given in the Air Suction system procedures in this Section. Since the oxygen sensors on the other engines are deeply linked to the computer-controlled fuel injection system, procedures for the testing the oxygen sensor(s) are included with the fuel injection diagnostic and repair procedures in Section 5.

DASHBOARD WARNING LIGHT

All vehicles covered by this book use a CHECK ENGINE warning lamp on the dashboard. The light is triggered by the engine control computer and indicates that the ECU has detected a fault within the system. Depending on the fault, drivability of the vehicle may be impaired when the light is on.

Some faults, particularly loss of critical input signals, will cause the computer to enter its default or "limp home" mode if necessary. This is a fail-safe program within the unit to prevent

the engine from shutting off totally due to signal loss. With a necessary signal no longer present, the computer is programmed to make certain assumptions and control the engine accordingly. Once this program is entered, the vehicle may not be capable of its full performance range because not all necessary information will be available to the computer. While driving the vehicle in its default mode may not be the most pleasant way to travel, it is designed to get you home.

The CHECK ENGINE light cannot be reset in the traditional method of pushing a button or resetting a maintenance counter. Each time the engine is started, the ECU conducts a check of its systems; if a fault is found, the dash warning lamp is lit. If the system checks "clean", the light remains off during vehicle operation. Thus, if the CHECK ENGINE warning lamp is lit, the only way to turn it off is to diagnose and repair the fault it has found. Complete diagnostics are given in Section 5.

Catalytic Converter

OPERATION

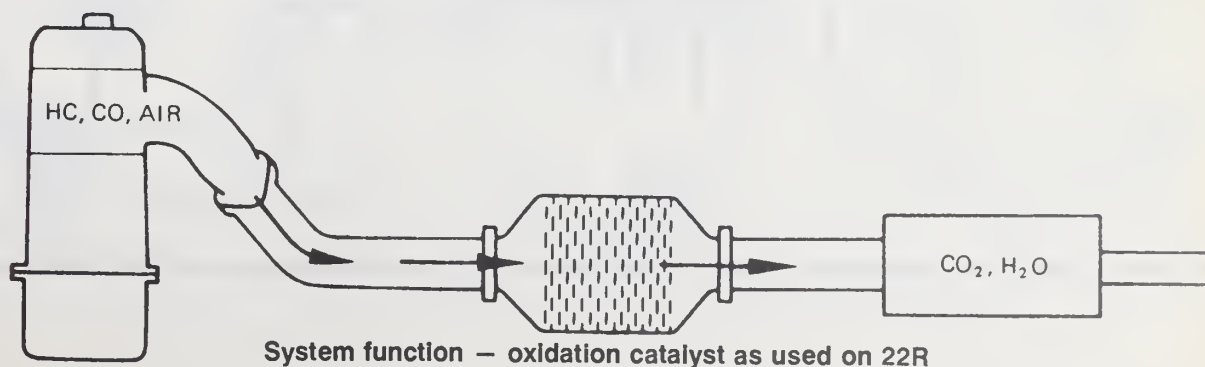
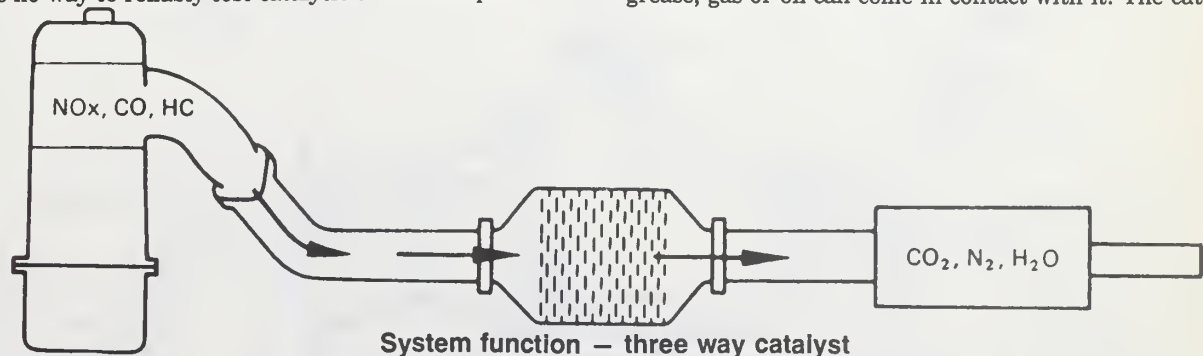
The catalytic converter is a muffler-like container built into the exhaust system to aid in the reduction of exhaust emissions. The catalyst element consists of individual pellets coated with a noble metal such as platinum, palladium, rhodium or a combination of them. When the exhaust gases come into contact with the catalyst, a chemical reaction occurs which reduces the pollutants into harmless substances such as water and carbon dioxide.

There are two types of catalytic converters: an oxidizing type and a three-way type. Both are used on Toyota trucks, although the oxidation type is found only with the 22R engine. The oxidizing catalyst requires the addition of oxygen to spur the catalyst into reducing the engine's HC and CO emissions into H₂O and CO₂.

tion with these substances will result in heat which may start a fire.

CATALYST TESTING

There is no way to reliably test catalytic converter operation



in the field. The only reliable test is a 12 hour and 40 min. "soak" test (CVA) which must be done in a laboratory. Tailpipe testing (emission testing) must be done with an exhaust gas analyzer, well out of the cost range of the owner/mechanic.

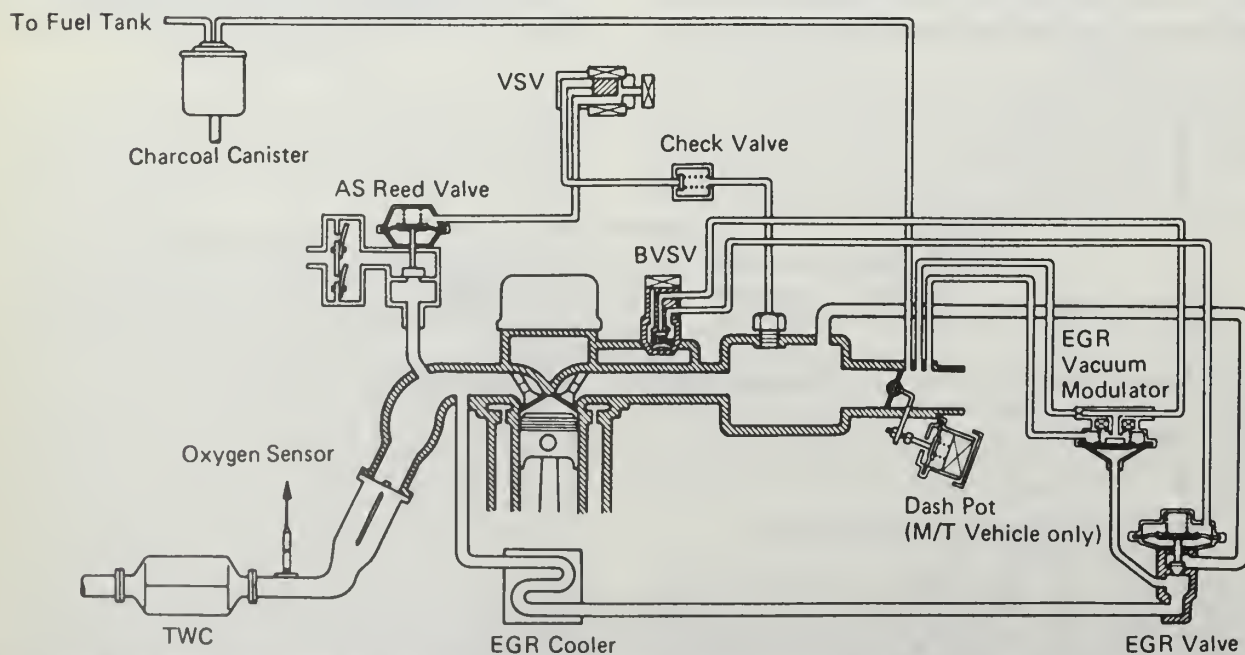
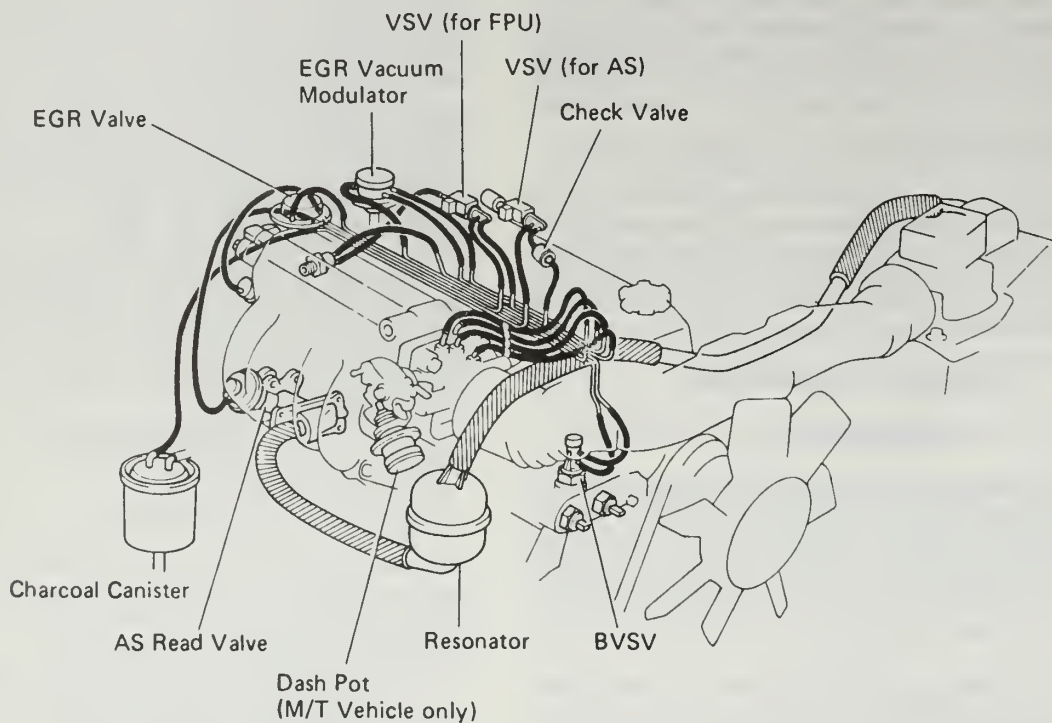
Many states and provinces now require emission testing of vehicles. This inexpensive test can be used as a basic indicator of system function as well as converter function. A properly operating system should test very close to 0 percent CO with HC readings well under 200 ppm. Even if this test is not required in your area, a well-equipped shop can perform the test as a diagnostic function. Testing the vehicle once every 2 or 3 years can be well worth the cost of the test.

Remember that the catalytic converter has no moving parts and is the last item in the exhaust/emissions system. If an emissions problem is indicated by a test, the chances are excellent that the problem originates elsewhere in the engine and the converter simply cannot deal with the gasses being sent to it. It is rare for a properly maintained (no leaded fuel) converter to fail or cause a problem.

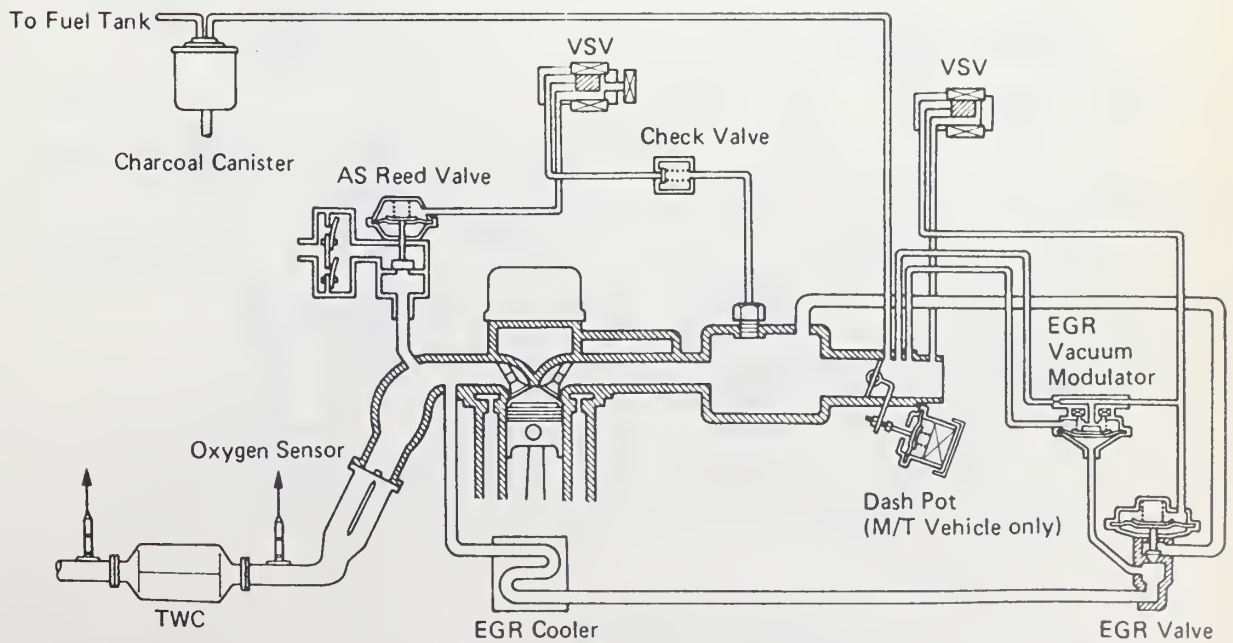
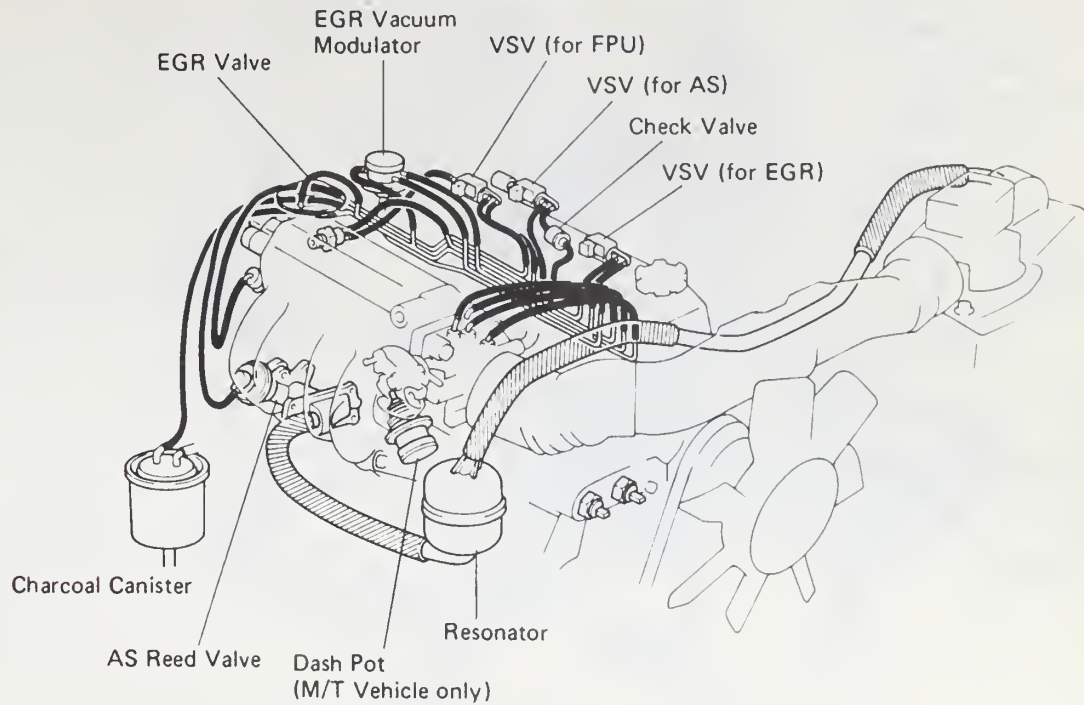
PRECAUTIONS

1. Use only unleaded fuel.
2. Avoid prolonged idling; the engine should run no longer than 20 min. at curb idle and no longer than 10 min. at fast idle.
3. Don't disconnect any of the spark plug leads while the engine is running. If any engine testing procedure requires disconnecting or bypassing a control component, perform the procedure as quickly as possible. A mis-firing engine can overheat the catalyst and damage the oxygen sensor.
4. Make engine compression checks as quickly as possible.
5. Whenever under the vehicle or around the catalytic converter, remember that it has a very high outside or skin temperature. During operation, the catalyst must reach 500 degrees to work efficiently. Be very wary of burns, even after the engine has been shut off for a while. Additionally, because of the heat, never park the vehicle on or over flammable materials, particularly dry grass or leaves. Inspect the heat shields frequently and correct any bends or damage.
6. In the unlikely event that the catalyst must be replaced, DO NOT dispose of the old one where anything containing grease, gas or oil can come in contact with it. The catalytic ac-

4 EMISSION CONTROLS

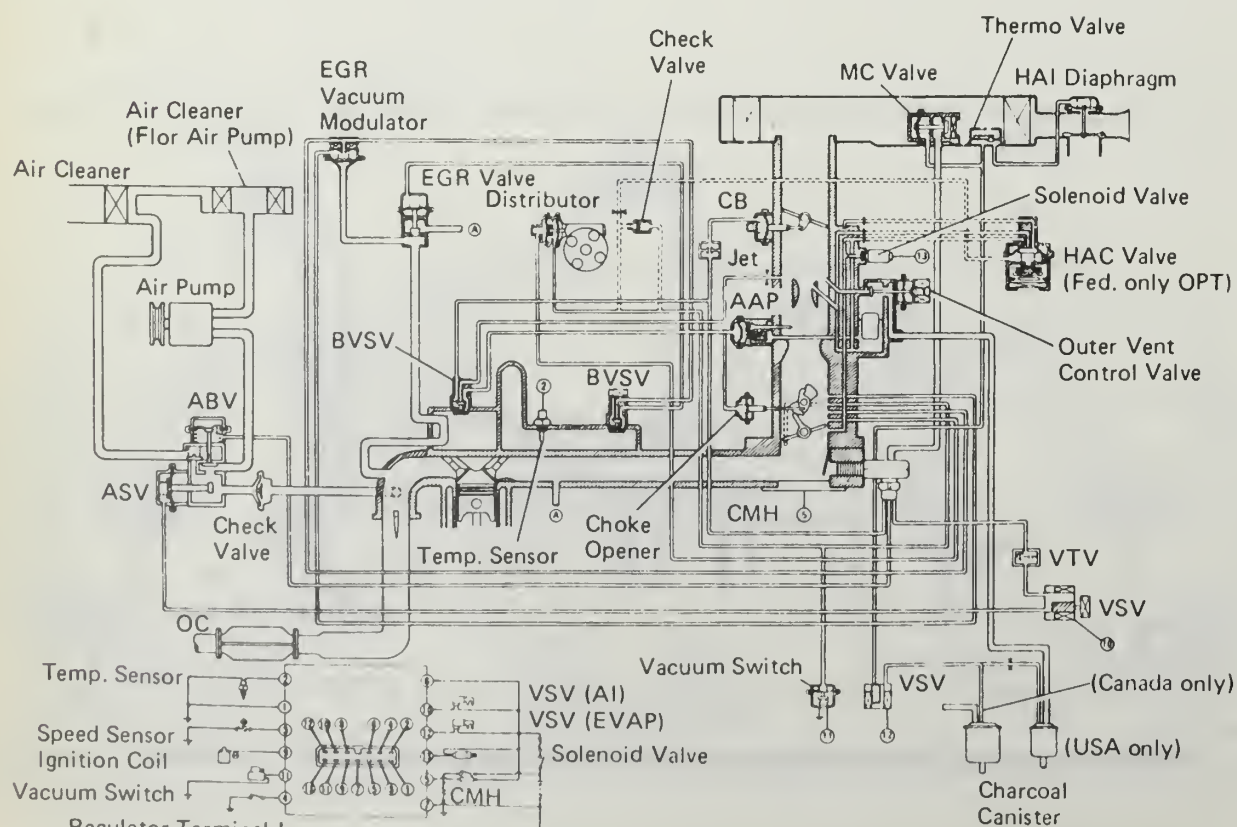
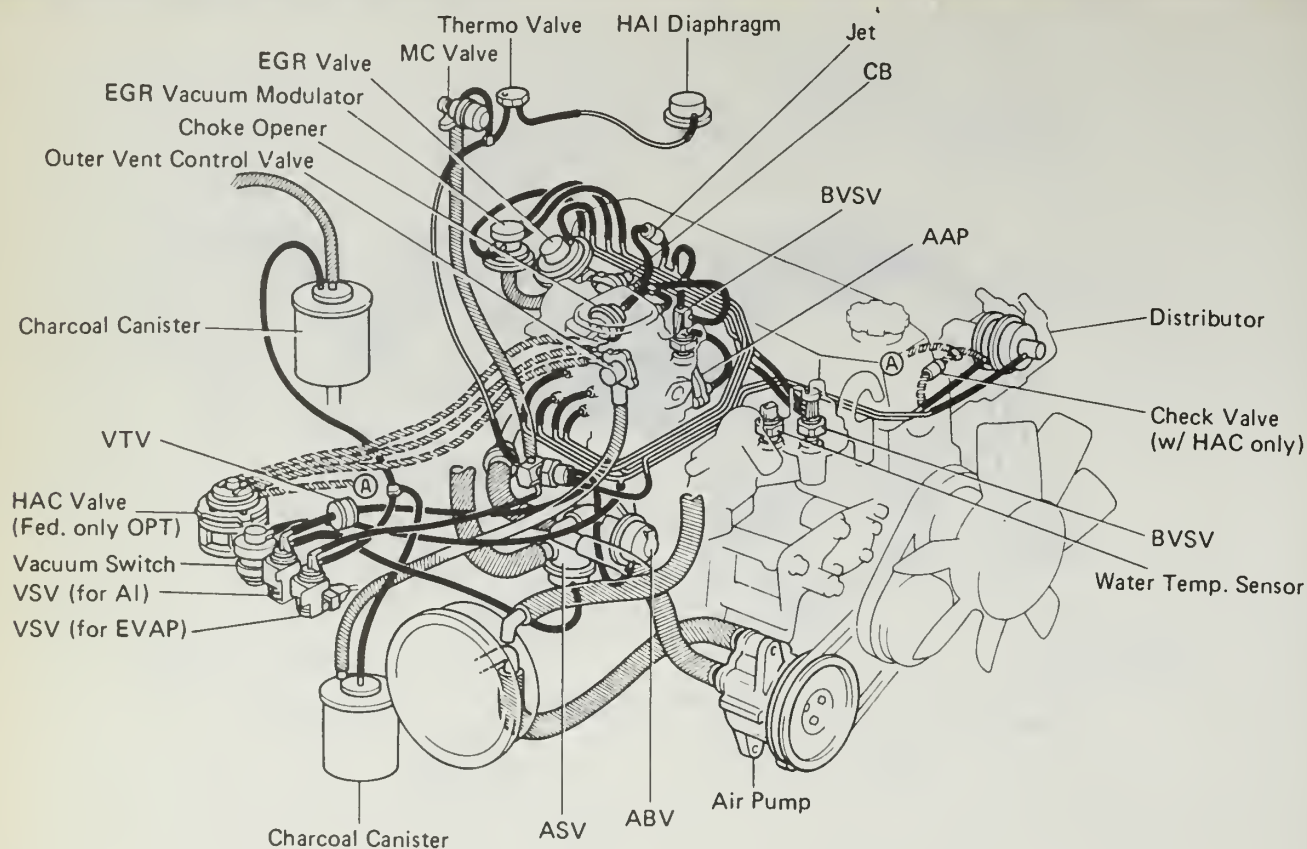


1989-90 Truck (Federal and Canada) and 4Runner (all) with 22R-E: Emissions component and system schematic



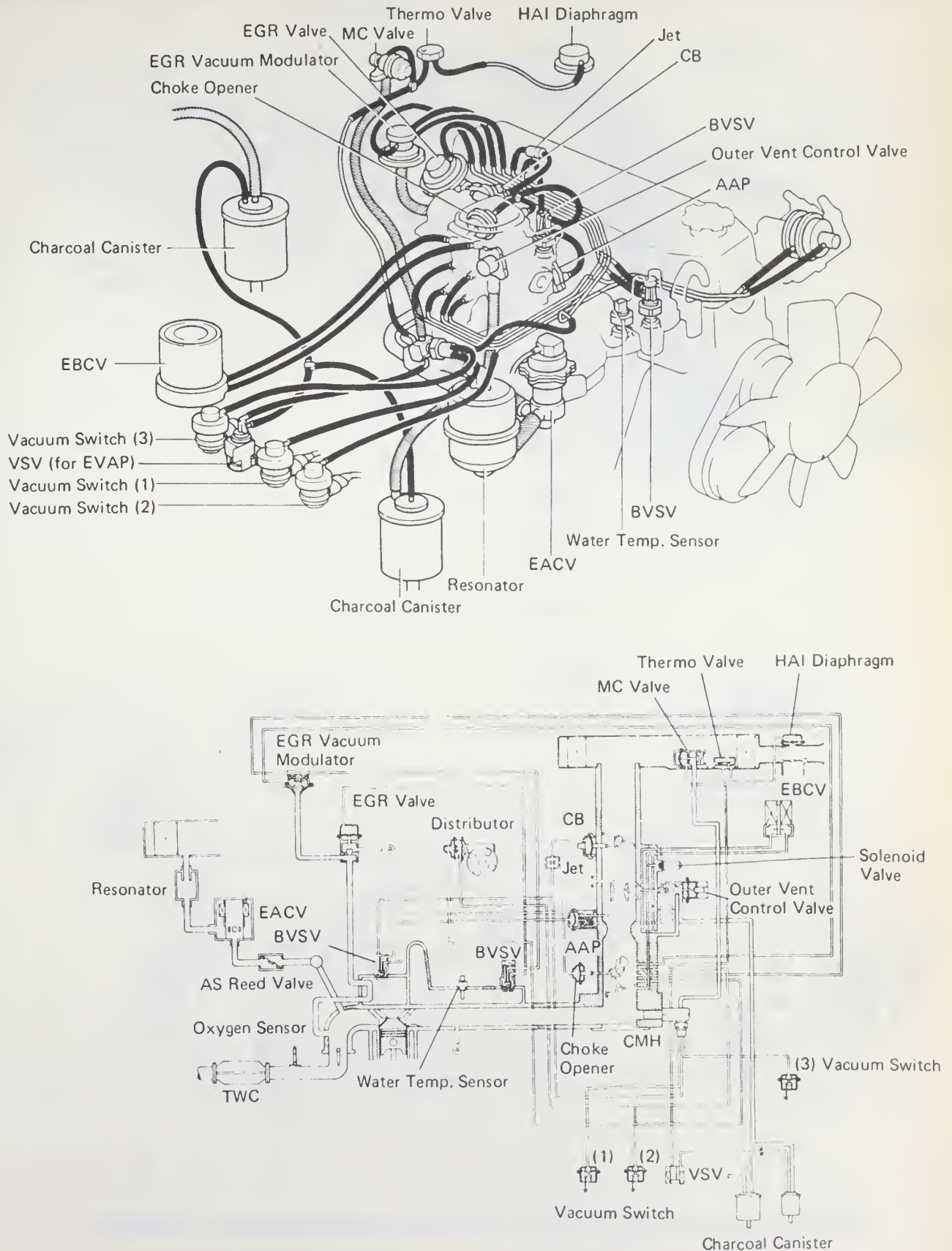
1989-90 Truck with 22R-E: Emissions component and system schematic — California

4 EMISSION CONTROLS



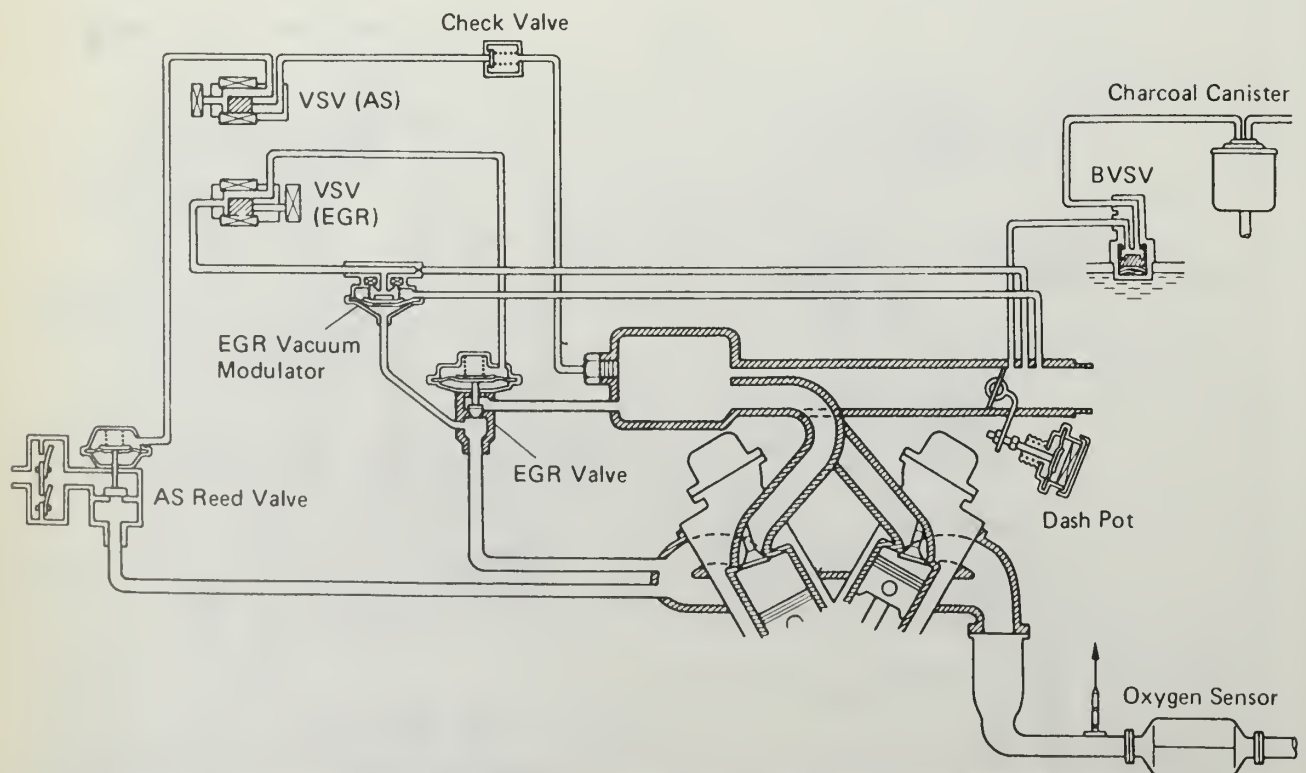
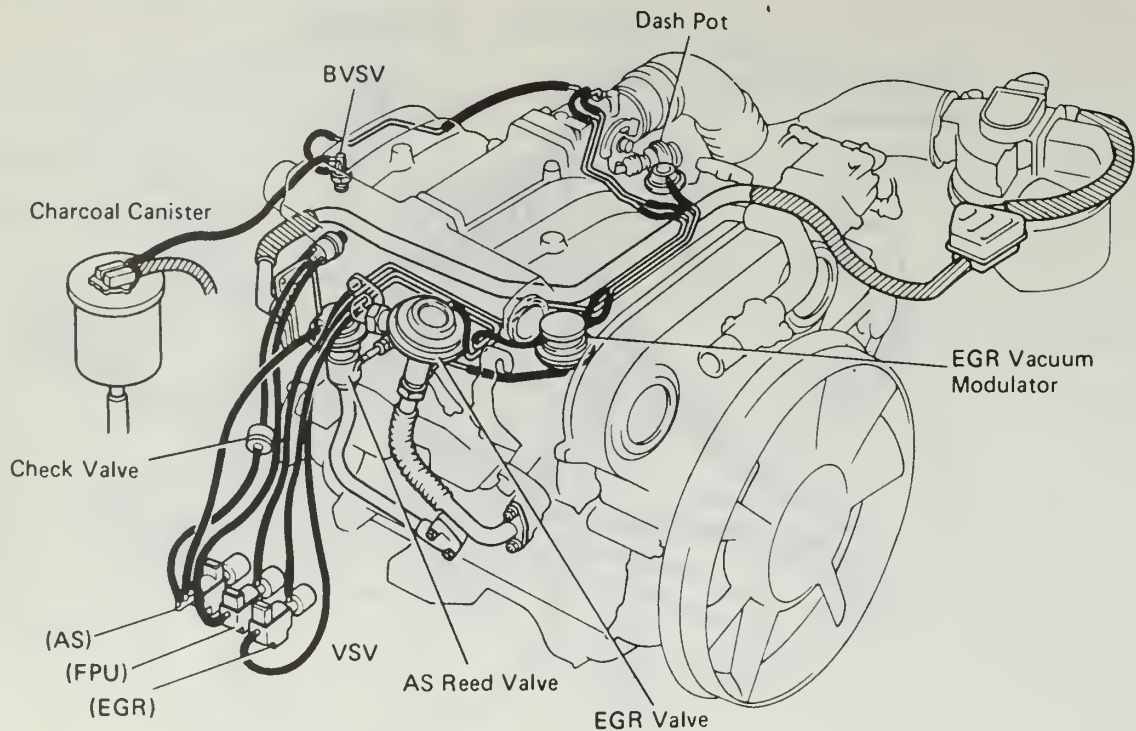
Regulator Terminal L

1989 Truck with 22R: Emissions component and system schematic — Federal and Canada

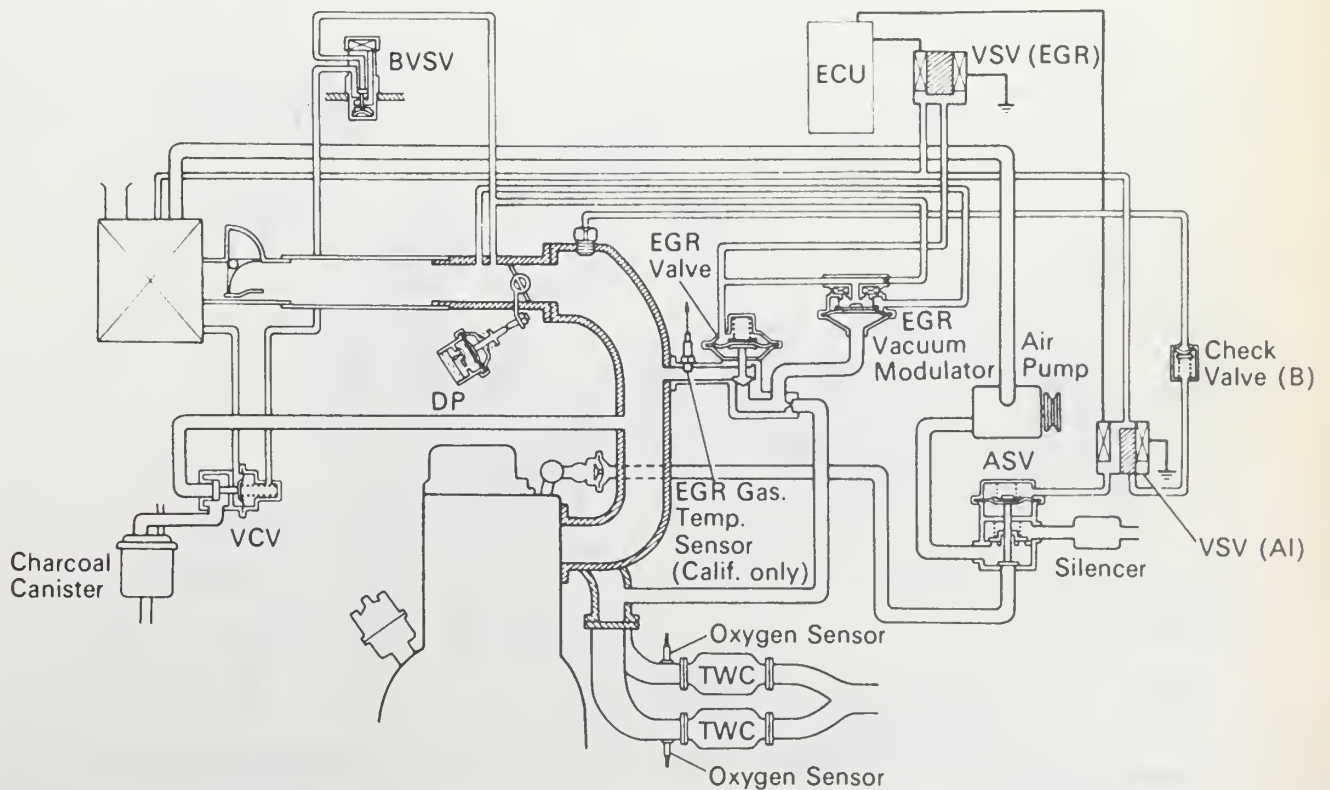
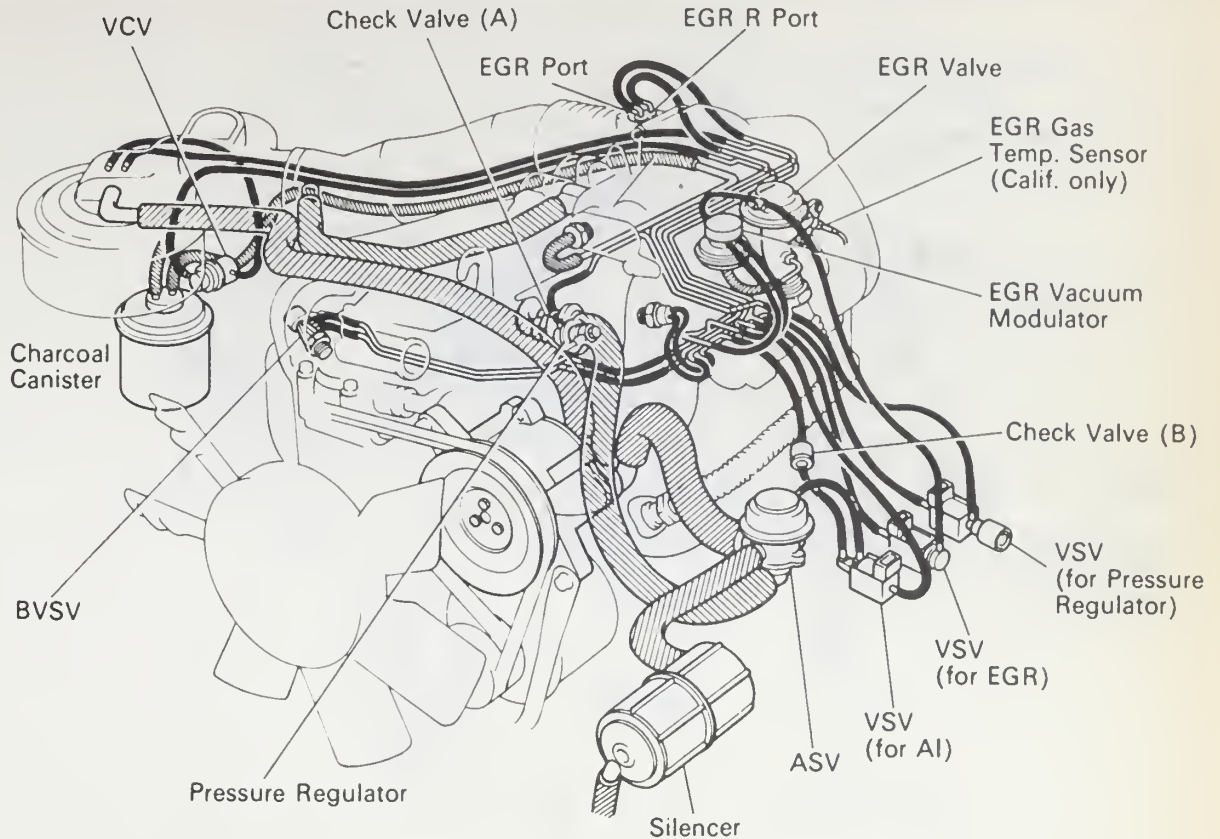


1989 Truck with 22R: Emissions component and system schematic — California

4 EMISSION CONTROLS

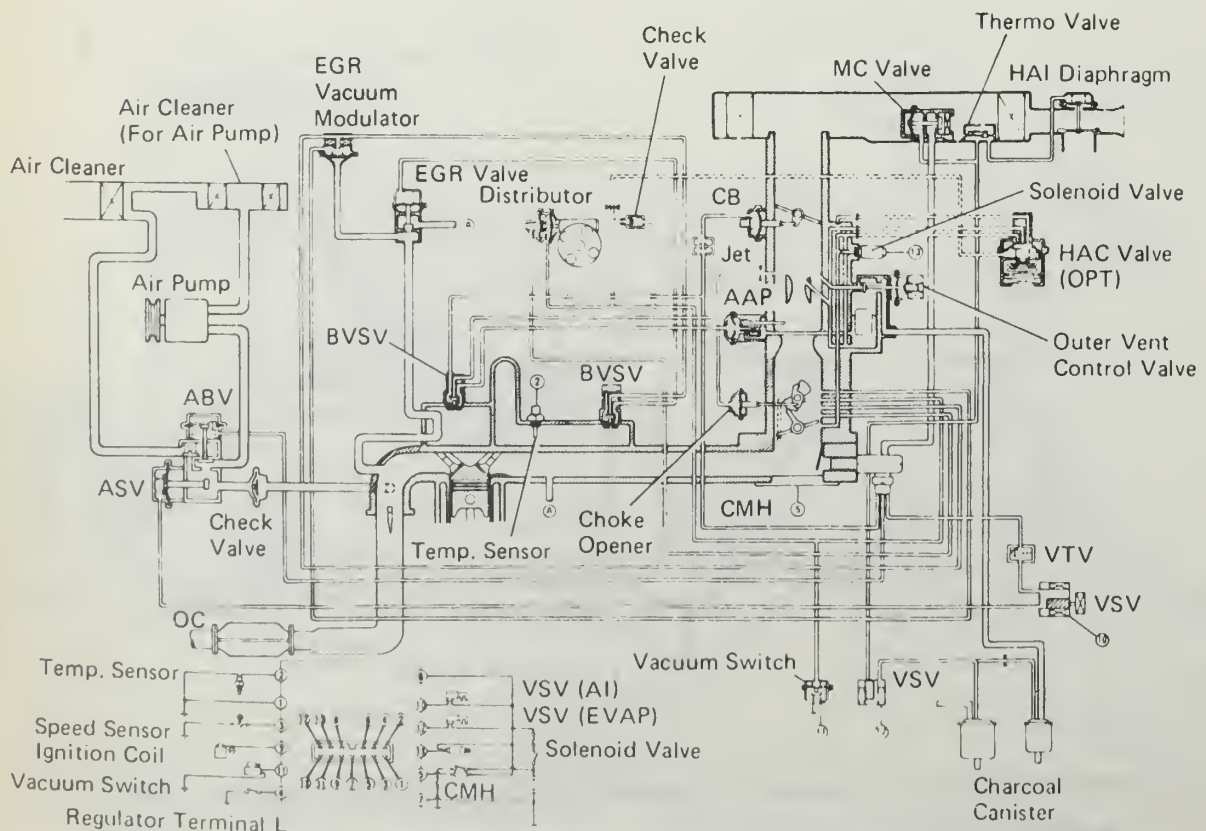
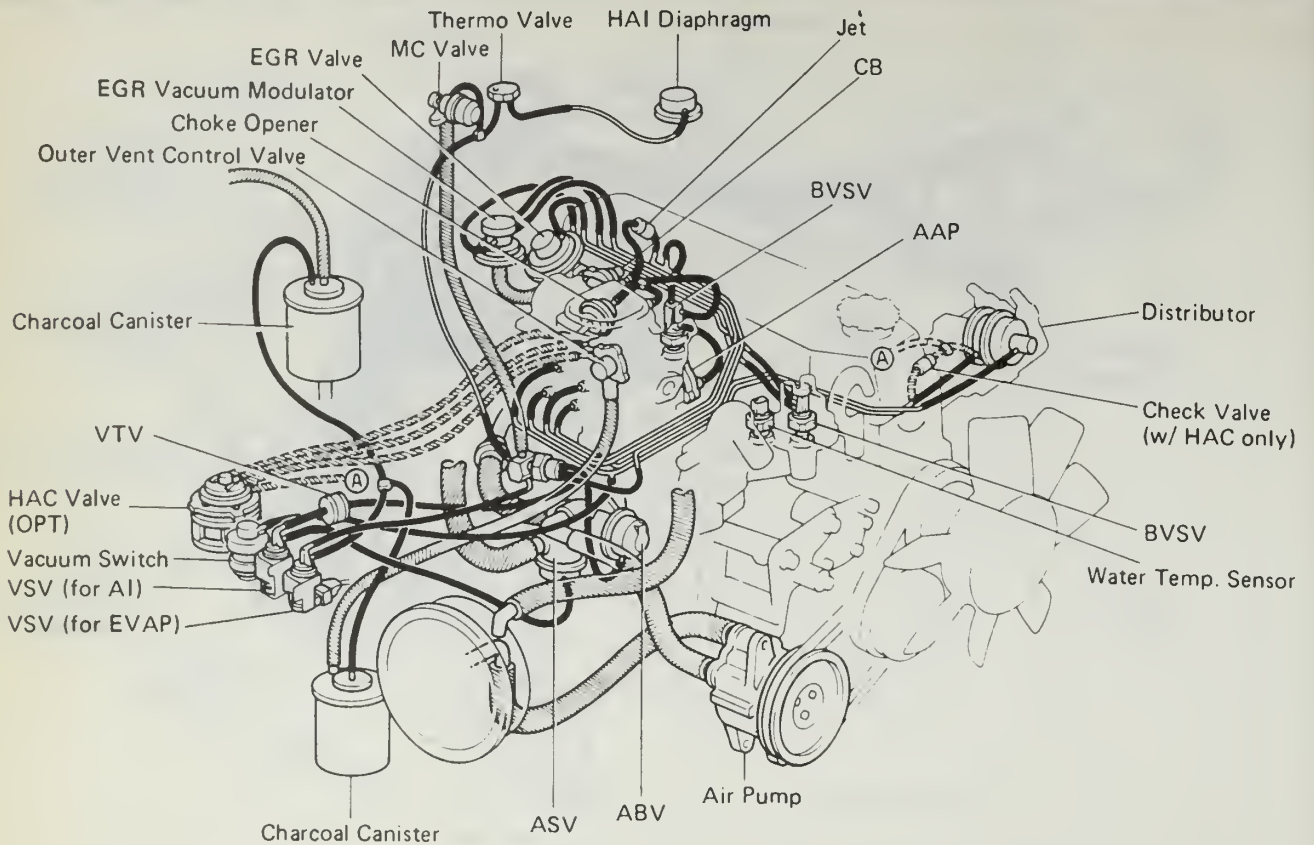


1989-91 Truck and 4Runner with 3VZ-E: Emissions component and system schematic TWC

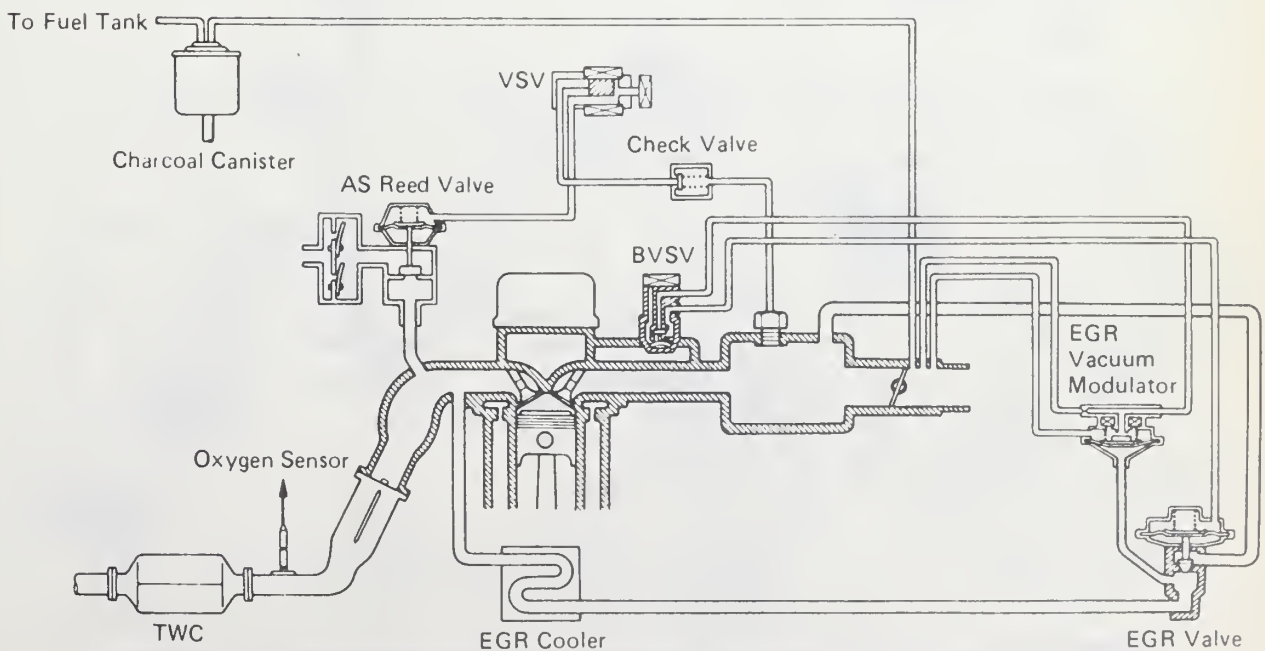
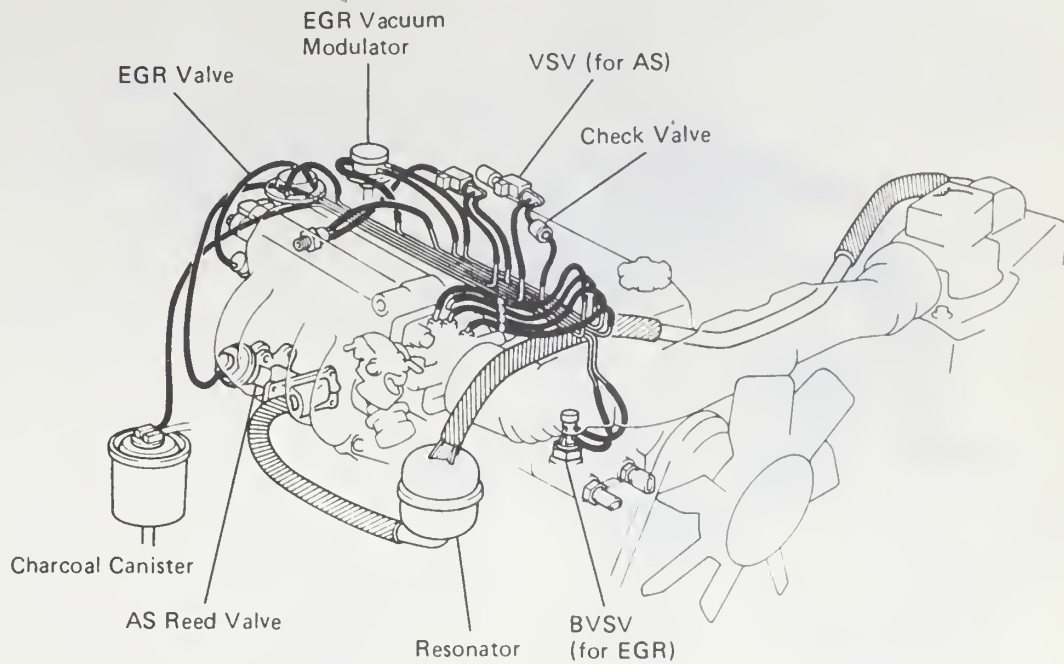


1989-90 Land Cruiser with 3F-E: Emissions component and system schematic

4 EMISSION CONTROLS

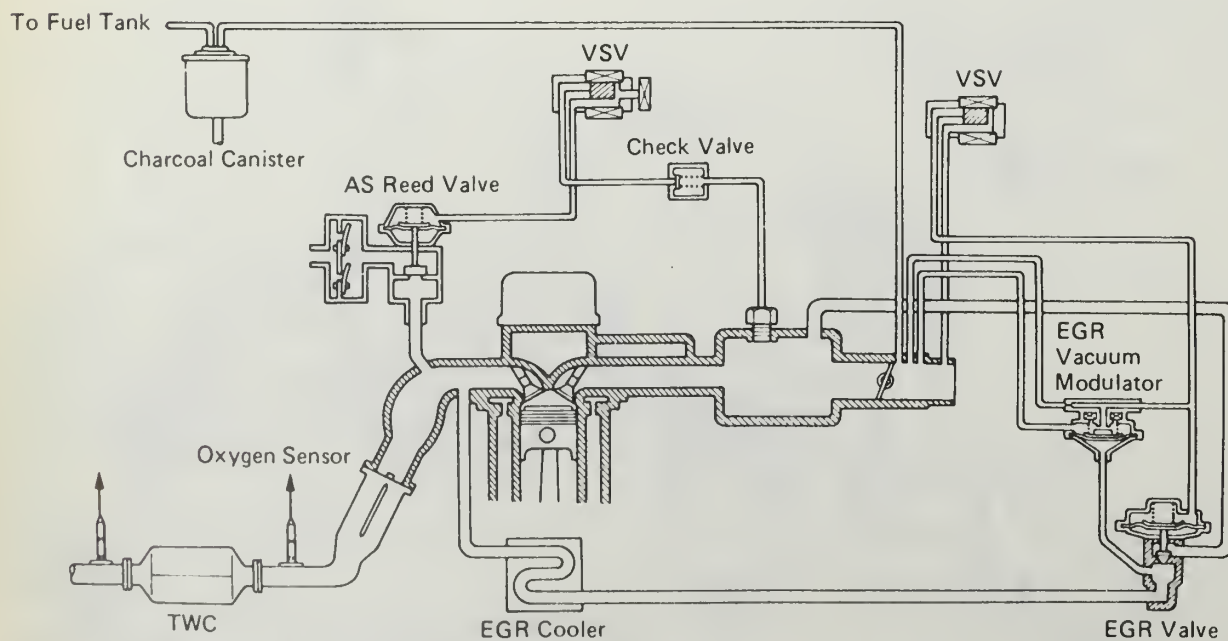
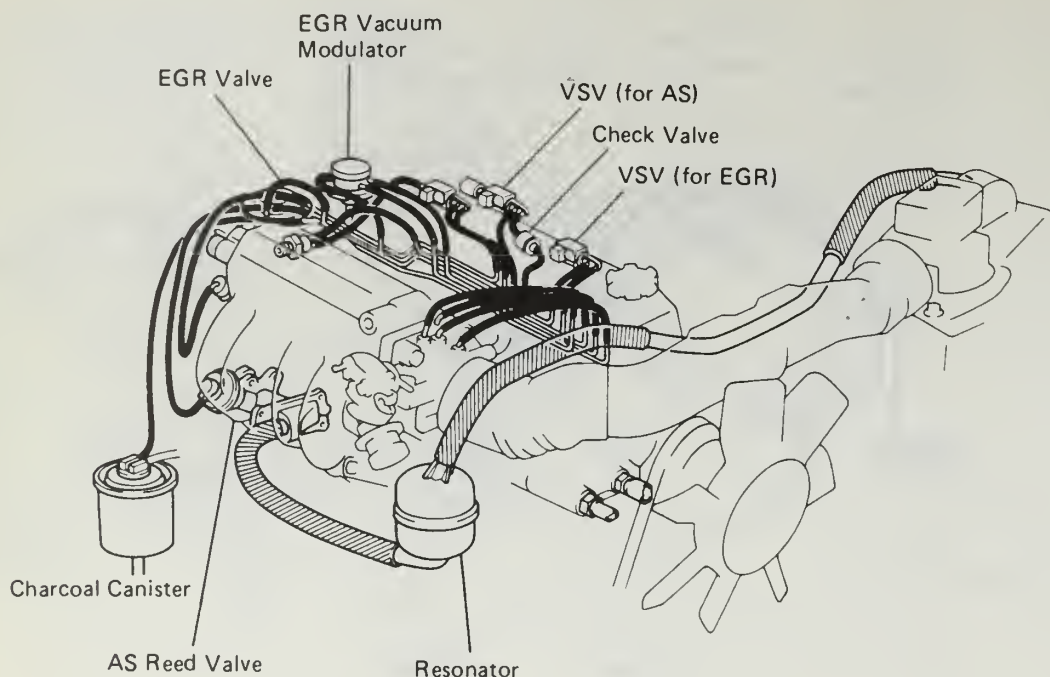


1990 Truck with 22R: Emissions component and system schematic

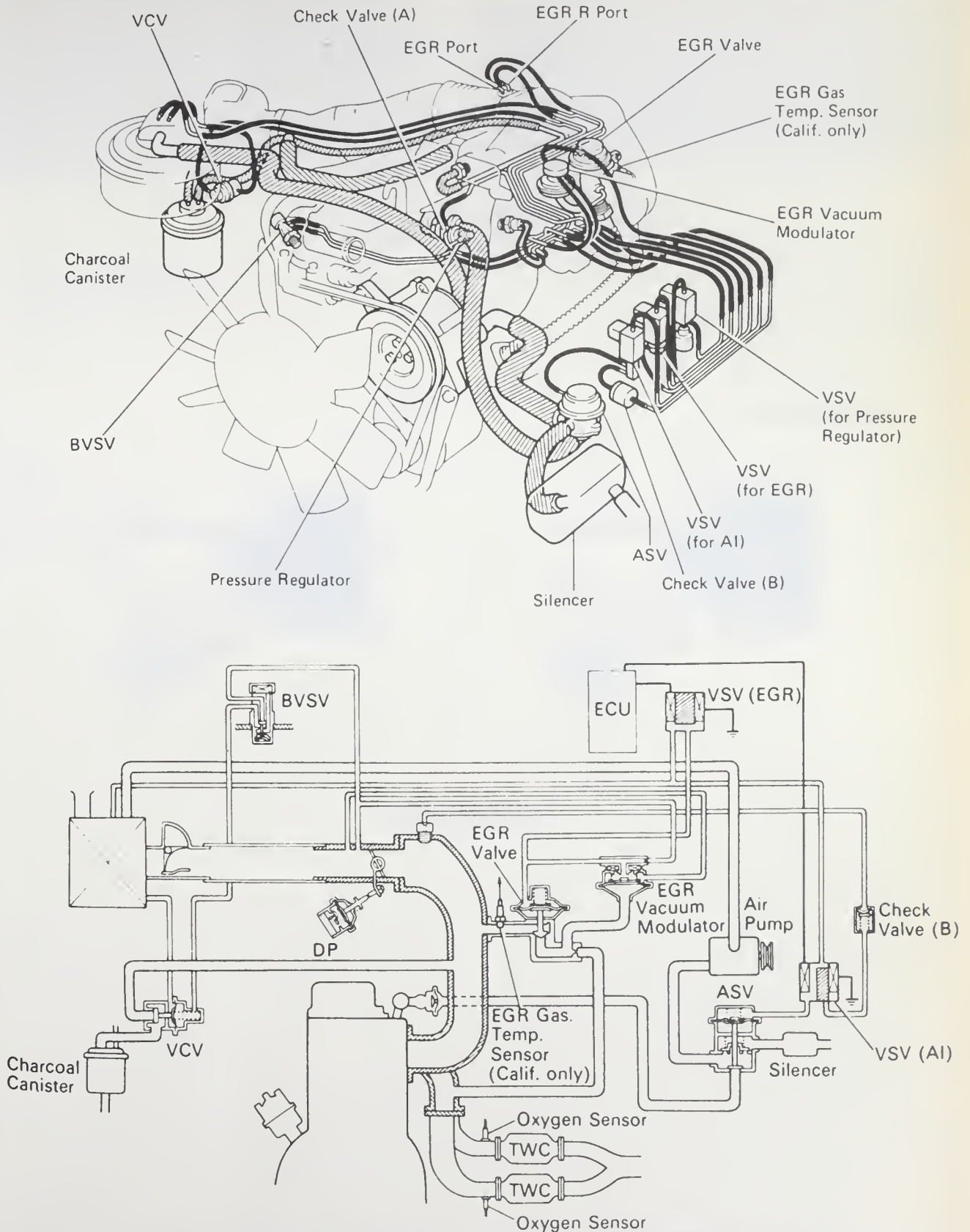


1991 Truck (Federal and Canada) and 4Runner (all) with 22R-E: Emissions component and system schematic

4 EMISSION CONTROLS

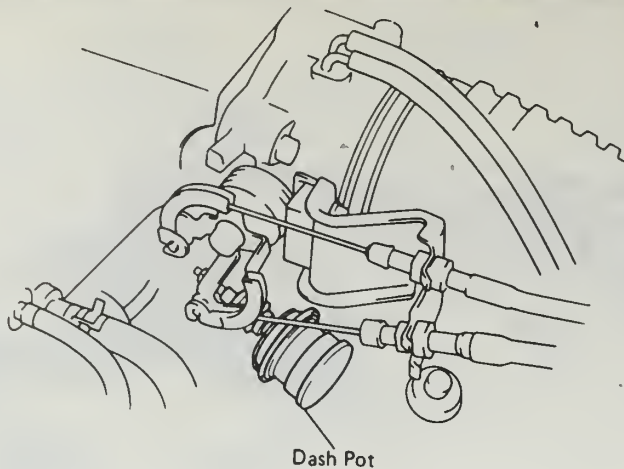


1991 Truck with 22R-E: Emissions component and system schematic — California

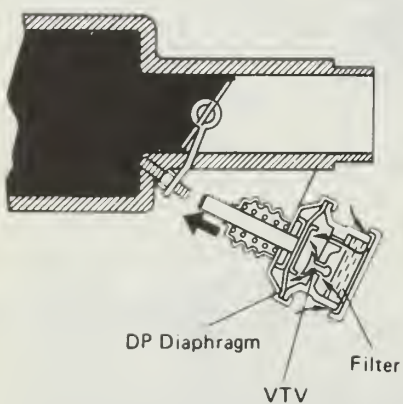


1991 Land Cruiser with 3F-E: Emissions component and system schematic

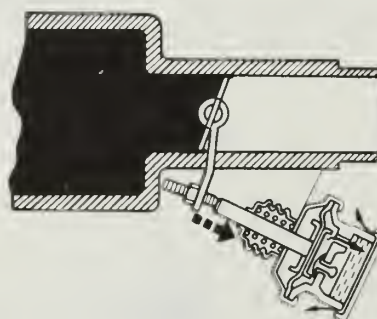
4 EMISSION CONTROLS



Normal Driving



Deceleration



Dashpot operation

5

Fuel System

QUICK REFERENCE INDEX

Carbureted Fuel System	5-142
Electronic Engine Controls	5-2
Fuel Injection Systems	5-148
Fuel Tank	5-154
Torque Specifications	5-148

GENERAL INDEX

Carburetor		Control unit	5-153	Fuel pump	
Adjustments	5-143	Diagnosis and testing	5-3	Electric	5-148
Overhaul	5-145	Fuel pump	5-148	Mechanical	5-142
Removal and Installation	5-143	Injectors	5-150	Fuel system	
Electronic Engine Controls	5-2	Throttle body	5-149	Carbureted	5-142
Electronic Fuel injection				Fuel injection	5-152
Cold start injector	5-152			Fuel tank	5-154

DIAGNOSTIC SYSTEMS

Feedback Carburetors

OPERATION

Found on the 1989 California-specification 22R and all 1990 22R engines, the feedback system employs computer control to aid in reduction of emissions. The older, non-computer system used vacuum and temperature signals to control the entry of air into the exhaust stream, but much more precise control can be gained by controlling this function with a small electronic control unit (ECU). The ECU is located behind the right kick panel in the passenger compartment.

The ECU is capable of receiving many inputs, interpreting them and controlling the necessary outputs. It monitors not only the operation of its input and output circuits but its own internal operation as well. The ECU receives input regarding engine rpm, vehicle speed, both vacuum switches (in the air suction system), the coolant temperature and most importantly, the oxygen sensor in the exhaust system.

The oxygen sensor provides the ultimate data on the condition of the exhaust. Reduced to its simplest explanation, the O₂ sensor reads the content of the exhaust and communicates electrically with the ECU. The microcomputer evaluates the signal and adjusts the amount of air admitted to the exhaust stream. The ECU signals the EBCV and EACV into or out of action depending on the needs of the moment.

In normal operating conditions, after the engine is warmed up, the air/fuel ratio is within the usable range of the oxygen sensor. By designing the carburetor to function near the ideal (stoichiometric) ratio of air and fuel, the air suction system can make up the difference for most driving conditions. If the exhaust content changes drastically, as with sudden deceleration, the pollutants may exceed the capacity of the catalytic converter. The constant process of checking the flow content and adding or limiting air is called closed loop operation.

FAULT CODES

The ECU contains a built-in self diagnostic system, through which electrical faults are identified, assigned a numeric code, and stored for retrieval. By analyzing various signals internally, the unit can identify (to a degree) the nature and/or location of a fault. The CHECK ENGINE lamp on the dashboard will light when the ECU detects a fault. The light goes out when the ECU checks the system after repairs and does not find a fault. Under normal conditions, the dash warning lamp will come on briefly during engine start-up and then go out. If it stays on or comes on when the engine is running, a fault has been found.

Additionally, the stored code(s) may be erased by removing the HAZ-HORN fuse (with the ignition OFF) in the underhood fusebox for at least 10 seconds. The time needed to clear the codes increases as the temperature decreases; on a very cold day, 20-30 seconds may be required. Removing the negative battery cable will also cancel the code but, unfortunately will also cancel every other memory on the vehicle. Unless resetting the clock, radio, etc. appeals to you, pull the fuse.

If any other work on the vehicle requires disconnection of the battery cable, it would be prudent to check for any stored codes before disconnection. Once the cable is pulled, the codes are lost.

Once repairs are completed, the vehicle must be test driven to confirm that (1) the existing code is now cleared and (2) no other or new codes are stored.

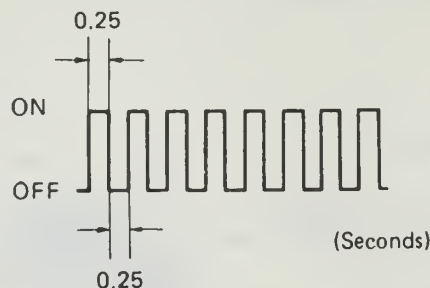
READING CODES

Codes are transmitted through the blinking of the CHECK ENGINE warning lamp. This only occurs when the system is

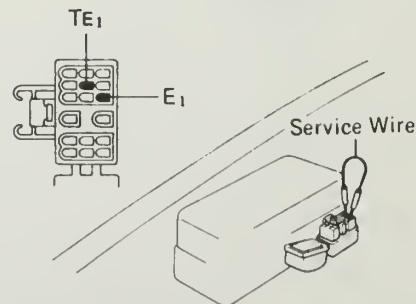
put into the diagnostic mode; it does not occur when the vehicle is moving.

You are reminded that the fault indicated by the code(s) refers to the system named, not necessarily the component named. In most cases, the component has not failed, but the ECU has lost its signal due to bad grounds, loose or corroded connectors, pinched wires or a blown fuse. The single worst mistake that is made when using computer diagnosis codes is to immediately swap parts instead of performing a proper circuit diagnosis. To read fault codes:

1. The following initial conditions must be met:
 - a. Battery voltage at or above 11 volts.
 - b. Throttle fully closed — keep your foot off the accelerator

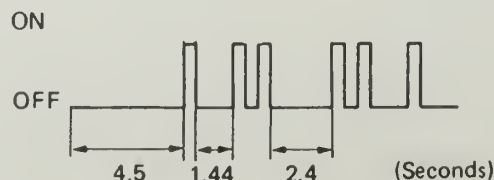


This is the "normal operation" code which should be present if no fault code is stored



These terminals must be connected to read 22R diagnostic codes

Code No. 12 Code No. 21



Examples of fault code transmission. Note the time spaces between numbers and groups of numbers

- c. Transmission in N or neutral.
- d. All electrical systems and accessories OFF.
2. Turn the ignition switch ON but do not start the engine.
3. Use the special jumper wire you made for tune-up work.

Connect terminals TE1 and E1 of the check connector.

4. The fault codes will be transmitted through the controlled flashing of the CHECK ENGINE dash warning light.

5. If no malfunction was found or no code was stored, the lamp will flash 2 times per second with no other pauses or pattern. This is the system's way of confirming that its diagnostic system is working but has not detected anything abnormal. This

normal operation signal should always be present if no other codes are stored.

6. The light will blink the number of the code(s). All codes are two digits; the pulsing of the light represents the digits, not the count. For example, Code 25 is displayed as two flashes, a 1½ second pause and five flashes. (Don't try to count 25 flashes.) If a more than one code is stored, the next will appear after a 2½ second pause. When all codes have been transmitted, there will be a 4½ second pause after which the entire string is repeated. The repeats will continue as long as both check connector terminals are connected.

FAULT CODES USED FOR 22R FEEDBACK CARBURETOR SYSTEM

Code No.	Number of check engine blinks	System	Diagnosis	Trouble area
-	 ON OFF	Normal	This appears when none of the other codes are identified.	
12		RPM Signal	No signal to ECU within several seconds after engine is cranked (TAC).	• Ignition coil circuit • Ignition coil • Igniter circuit • Igniter • ECU
21		Oxygen Sensor Signal	Detects deterioration of the oxygen sensor.	• Oxygen sensor circuit • Oxygen sensor • ECU
22		Water Temp. Sensor Signal	Open or short circuit in water temp. switch signal (THW).	• Water temp. sensor circuit • Water temp. sensor. • ECU
25		Lean Malfunction	• Open circuit in oxygen sensor signal (OX). • EBCV and/or EACV always open. • Short circuit in EBCV signal.	• Oxygen sensor circuit • Oxygen sensor • EBCV and/or EACV circuit • EBCV and/or EACV • ECU
26		Rich Malfunction	• EBCV and/or EACV always closed, or a clogged hose. • Open circuit in and/or EACV signal.	• EBCV and/or EACV circuit • EBCV hose • EBCV and/or EACV • ECU
31		Vacuum Switch Signal	Open or short circuit in vacuum switches signal (VSW1, VSW2, VSW3).	• No. 1, No. 2 or No. 3 vacuum switches signal • No. 1, No. 2 or No. 3 vacuum switches • EGR
42		Vehicle Speed Sensor Signal	Open or short circuit in vehicle speed sensor signal (SPD).	• Vehicle speed sensor circuit • Vehicle speed sensor • ECU
71		EGR Malfunction	• EGR valve normally closed, or a clogged hose. • Open circuit in EGR gas temp. sensor signal (THG).	• EGR valve • EGR vacuum modulator • EGR hose • EGR gas temp. sensor circuit • EGR gas temp. sensor • ECU
72		Fuel cut Solenoid Signal	Open circuit in fuel cut solenoid signal (FCS).	• Fuel cut solenoid circuit • Fuel cut solenoid • ECU

5 FUEL SYSTEM

NOTE: If several codes are stored, they will be transmitted in numerical order from smallest to largest. This does NOT indicate the order of occurrence.

7. Always write down the codes.

8. After viewing the code(s) at least twice to confirm and record the correct numbers, remove the jumper from the check connector and turn the ignition OFF.

TROUBLESHOOTING

The troubleshooting procedures are designed to be performed with a volt-ohmmeter instead of expensive test equipment. There are procedures for checking each separate circuit or system, including the ability of the ECU to check itself.

Before beginning extended troubleshooting procedures, check the obvious first; look for blown fuses or links, loose connectors, chafed or pinched wiring, etc. Perform all tests with the connectors connected unless specifically directed to disconnect them.

WARNING: All tests **MUST** be performed with a high impedance digital volt/ohmmeter (DVOM). Meter impedance must be at least 10,000Ω (10 kΩ) per volt. Lower impedance meters will damage the ECU and system components.

Use extreme care when probing connectors. Don't force the probes into the cavity and absolutely avoid any shorting between terminals. The ECU is extremely expensive and, being electronic, can be instantly and permanently damaged. You're working on your own vehicle to save money, not to cause more damage.

When testing at the ECU, it will be easier to remove the unit from its mount and gently (gently!) bring it as far into the passenger compartment as the harness will allow. This will allow more room to identify and probe terminals. Note that these test procedures check the signals into and out of the ECU, usually at the ECU. Testing of individual components should be conducted by referring the appropriate test in this or other Sections of the book. Most component tests will be found in Section 4.

Fuel Injection Systems OPERATION

Fuel injection allows precisely measured fuel to be introduced into the engine to maintain the ideal air/fuel mixture. (Well, very close, anyway). Besides the required benefits in emission reduction, the engine also provides better fuel mileage and performance. This precise balancing act is overseen by the ECU or electronic control unit (sometimes called the engine control unit or black box.)

Remember that emissions can only be held at minimum if the engine is ingesting an almost perfect air/fuel ratio of 14.7 parts of air for every part of fuel. This 14.7:1 (stoichiometric) ratio is essential to the correct operation of both the engine and the catalytic converter.

In a carburetor, air flow, created by the vacuum of the piston downstroke, sucks fuel from the bowl through a metering nozzle or jet. The fuel is mixed with the air and introduced into the engine. The amount of both air and fuel can vary dramatically with engine speed, load and temperature. In most cases, carburetion was found to be too imprecise to meet the stringent Federal regulations imposed on manufacturers.

Electronic fuel injection (EFI) systems use the ECU to interpret signals from all involved engine systems as well as the ever-present oxygen sensor(s) in the exhaust stream. By knowing the exact state of the engine from the sensors, the condition of the exhaust from the oxygen sensor and the amount of air entering the engine from the air flow sensor, the ECU can compute the proper amount of fuel to mix into the air entering the engine.

The ECU output actually controls the amount of time each injector stays open (duration) to allow fuel to pass. (Fuel pressure in the system is constant so the only way to control the amount of fuel is to control the duration.) Each injector is controlled by the ECU, opening and closing according to the needs of the moment. The injectors are located as close to the valves as possible so that the fuel is completely introduced into the cylinder.

The electronic control units have been so successful at maintaining emissions levels and driveability that they have been assigned more and more responsibilities. Toyota's computer control system is called TCCS; depending on the model and engine, the ECU may oversee the operation of the electronic spark advance, the diagnostic network, the electronically controlled transmission and even the idle speed as well as the fuel injection. The ECUs become more sophisticated (and more expensive) every year; as computer technology grows, so does the capacity of the control unit. Aside from outright abuse or electrical stupidity during repair, these solid-state units rarely fail and never need maintenance.

Since the ECU relies on many signals to make its decisions, loss of any signal alone or in combination can be devastating. The ECU is programmed with a back-up or fail-safe circuit to allow the vehicle to continue operating should any signal be lost. If an abnormality is detected, the fail-safe or default circuit provides fixed values for the calculations. While these values may not allow full vehicle performance, the engine will run based on standard injection and timing parameters. The CHECK ENGINE warning lamp on the dashboard will illuminate when the system detects a fault and/or enters the fail-safe mode.

FAULT CODES

The ECU contains a built-in self diagnostic system, through which electrical faults are identified, assigned a numeric code, and stored for retrieval. By analyzing various signals internally, the unit can identify (to a degree) the nature and/or location of a fault. The CHECK ENGINE lamp on the dashboard will light when the ECU detects a fault. The light goes out when the ECU checks the system after repairs and does not find a fault. Under normal conditions, the dash warning lamp will come on briefly during engine start-up and then go out. If it stays on or comes on when the engine is running, a fault has been found.

Additionally, the stored code(s) may be erased by removing the 15 amp EFI fuse (with the ignition OFF) from the fusebox for at least 30 seconds. The time needed to clear the codes increases as the temperature decreases; on a very cold day, 50-60 seconds may be required. Removing the negative battery cable will also cancel the code but, unfortunately, will also cancel every other memory on the vehicle. Unless resetting the clock, radio, etc. appeals to you, pull the fuse.

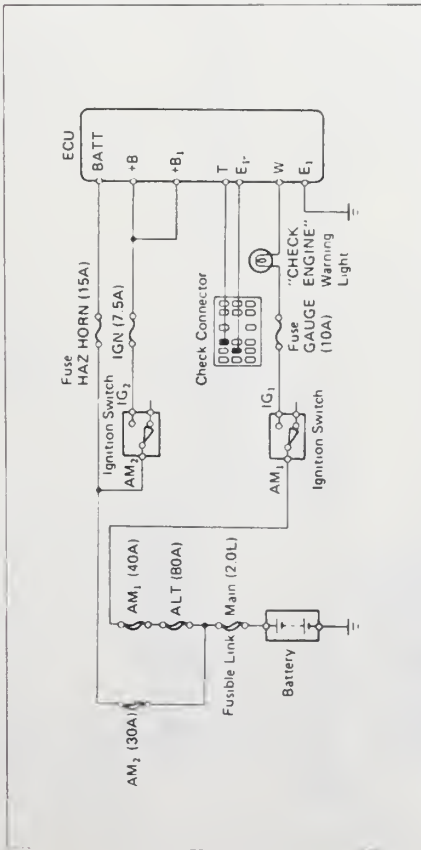
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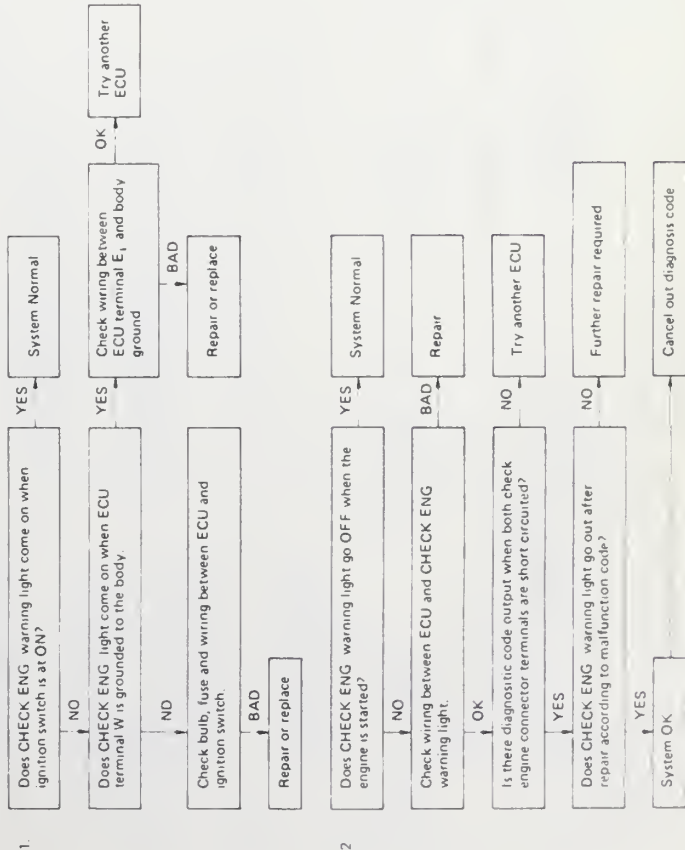
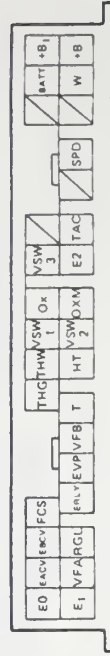
READING CODES

Codes are transmitted through the blinking of the CHECK ENGINE warning lamp. This only occurs when the system is put into the diagnostic mode; it does not occur when the vehicle is moving.

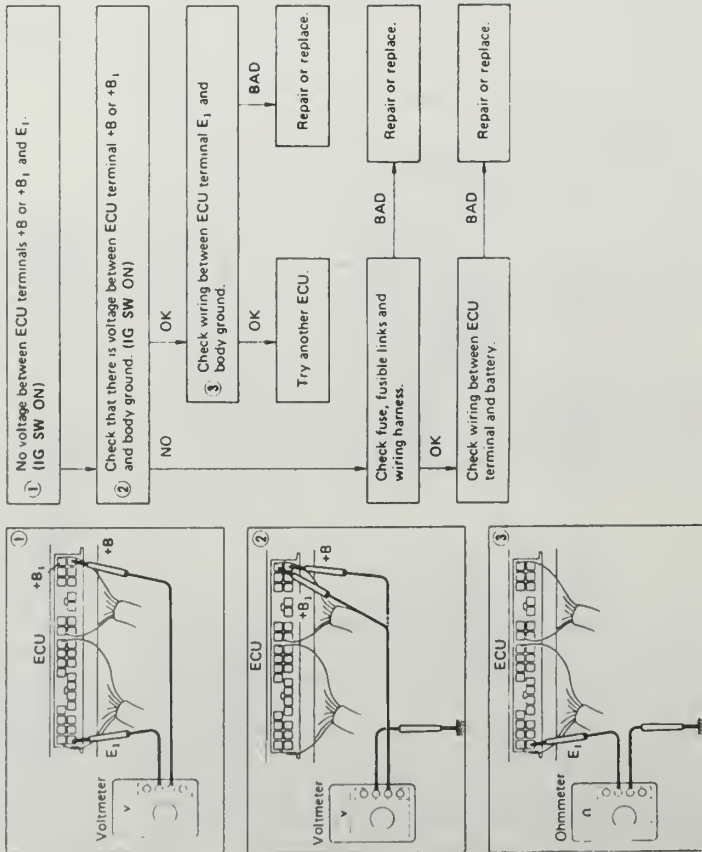
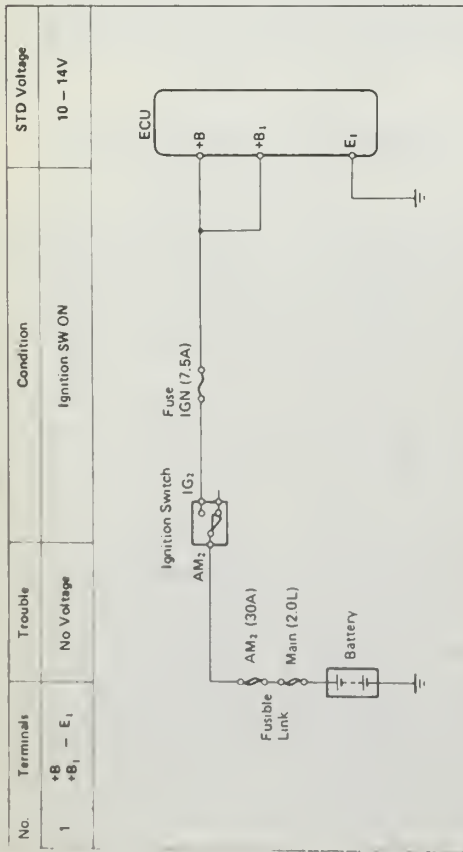
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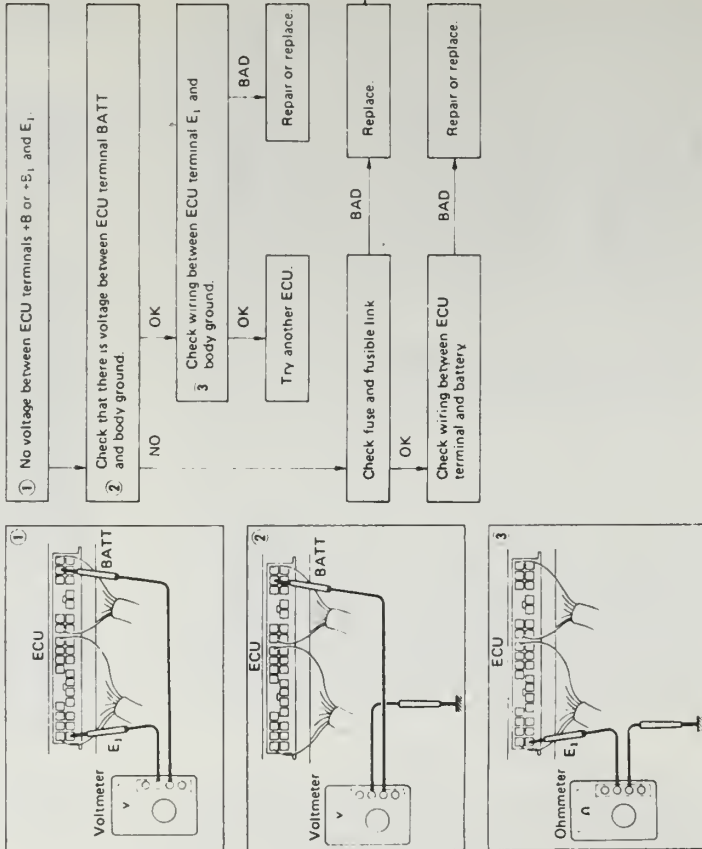
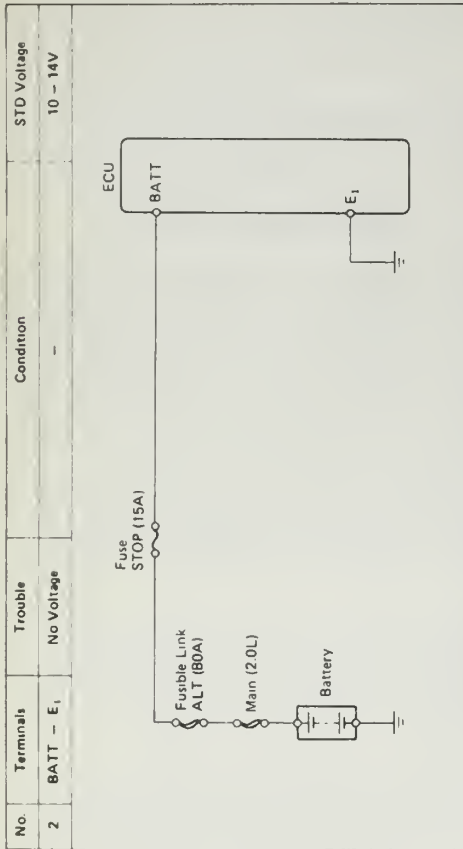
E0	POWER GROUND	VSW1	VACUUM SWITCH 1
E1	SENSOR GROUND	VSW2	VACUUM SWITCH 2
EACV	EACV	Ox	OXYGEN SENSOR
VFA	CHECK CONNECTOR	OxM	CHECK CONNECTOR
EACV	EBCV	VSW3	VACUUM SWITCH 3
RGL	REGULATOR	E2	SENSOR GROUND
FCS	FUEL CUT SOLENOID	TAC	IGNITION COIL ⊖
ERLY	CMH RELAY	SPO	VEHICLE SPEED SENSOR
EVP	EVAP PURGE VSV	BATT	BATTERY
VFB	CHECK CONNECTOR	W	WARNING LIGHT
T	CHECK CONNECTOR	+B1	IGNITION SWITCH
THG	EGR GAS TEMP. SENSOR	+B	IGNITION SWITCH
THW	WATER TEMP. SENSOR	HT	OXYGEN SENSOR HEATER

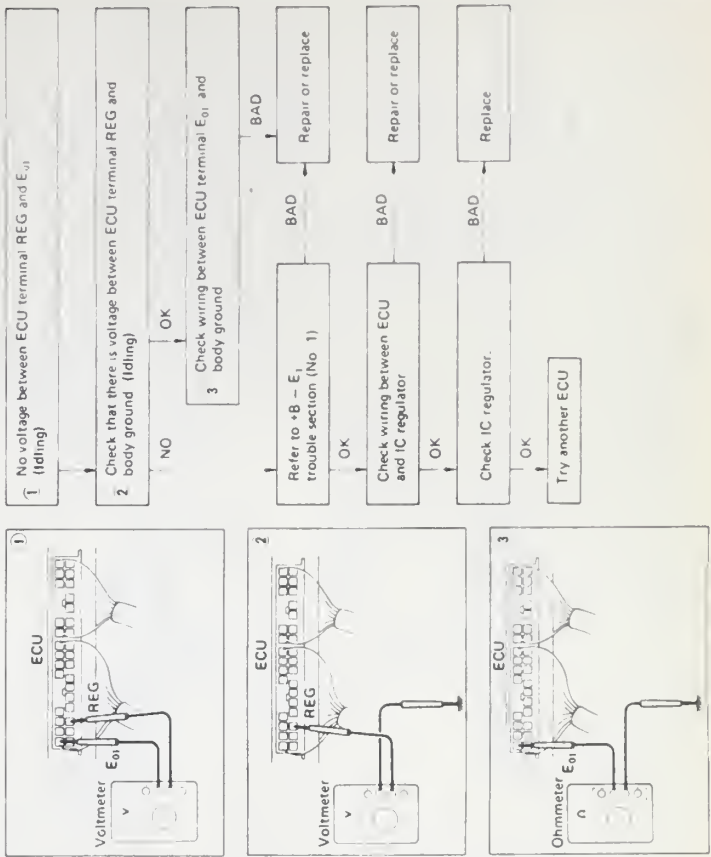
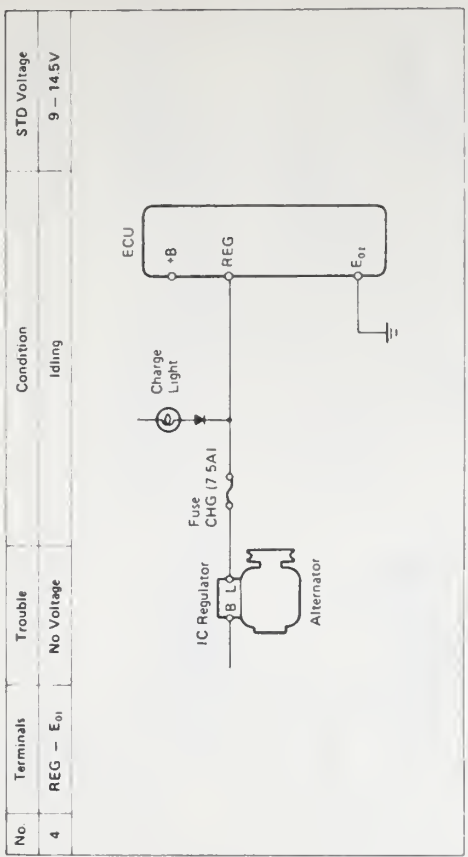
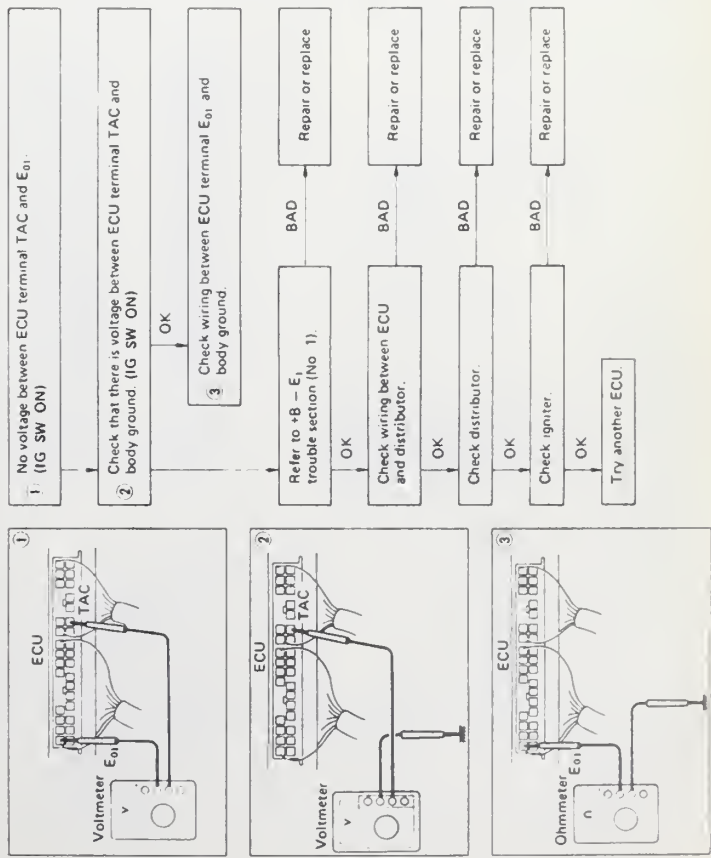
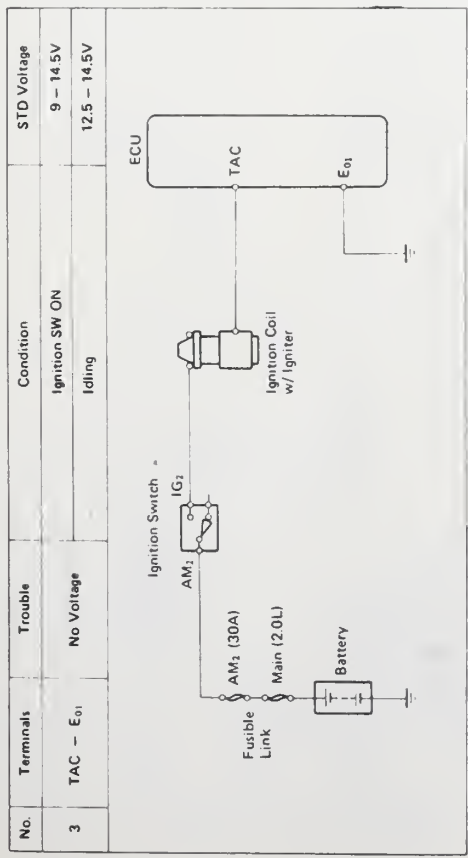


ECU TEST NO. 1 - 22R

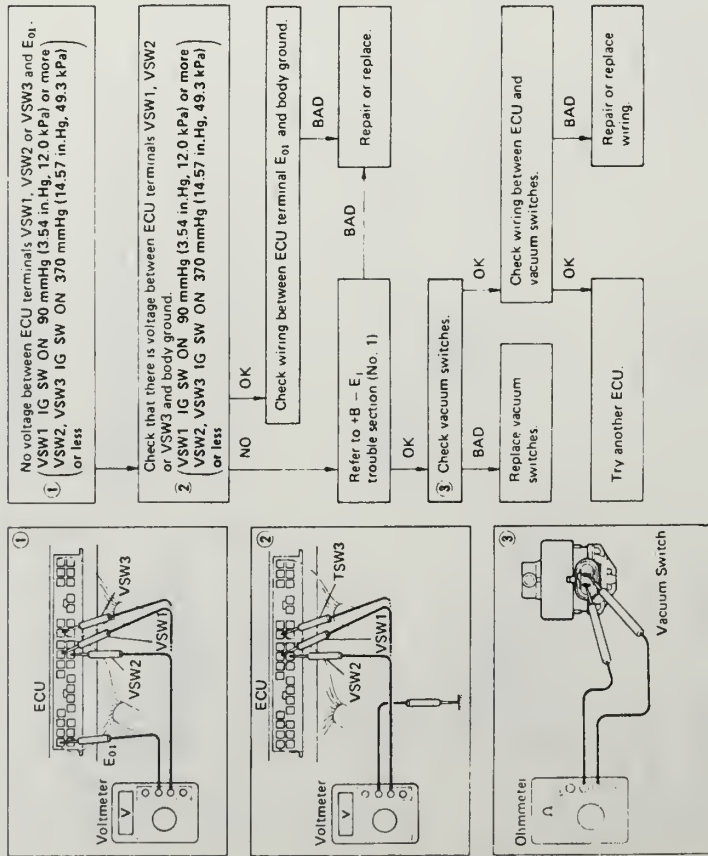
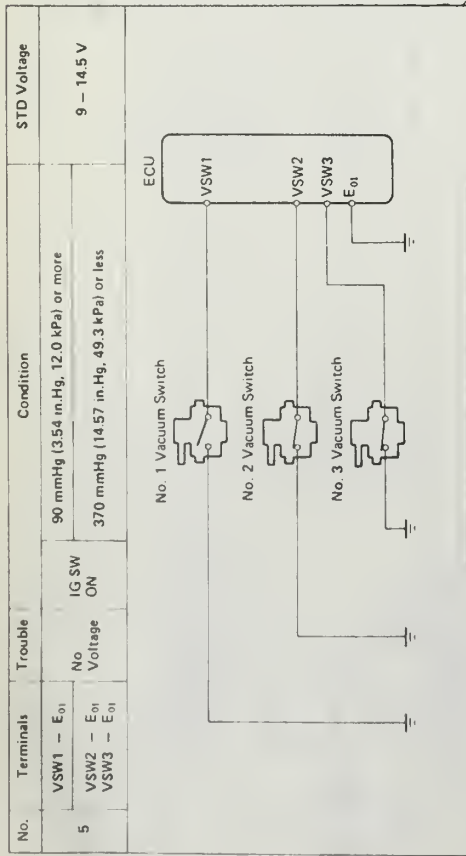


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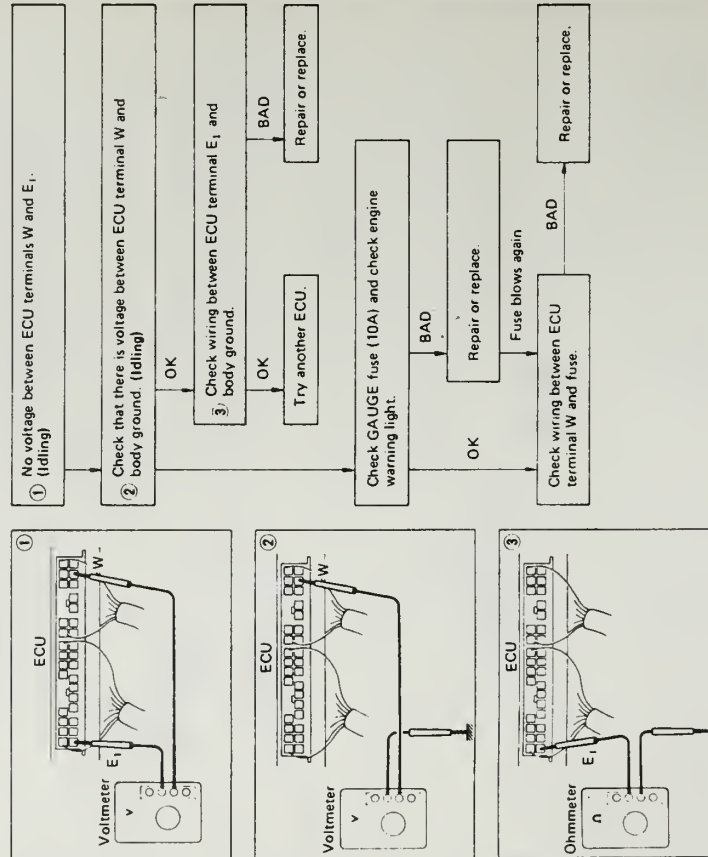
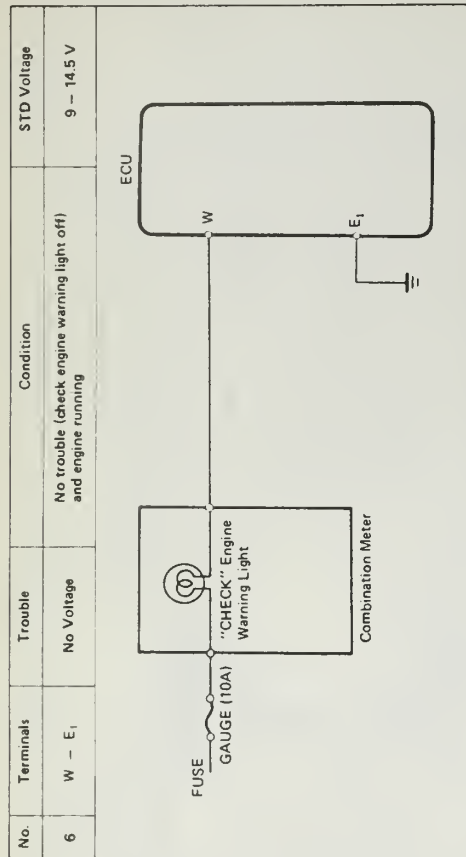




ECU TEST NO. 5 - 22R

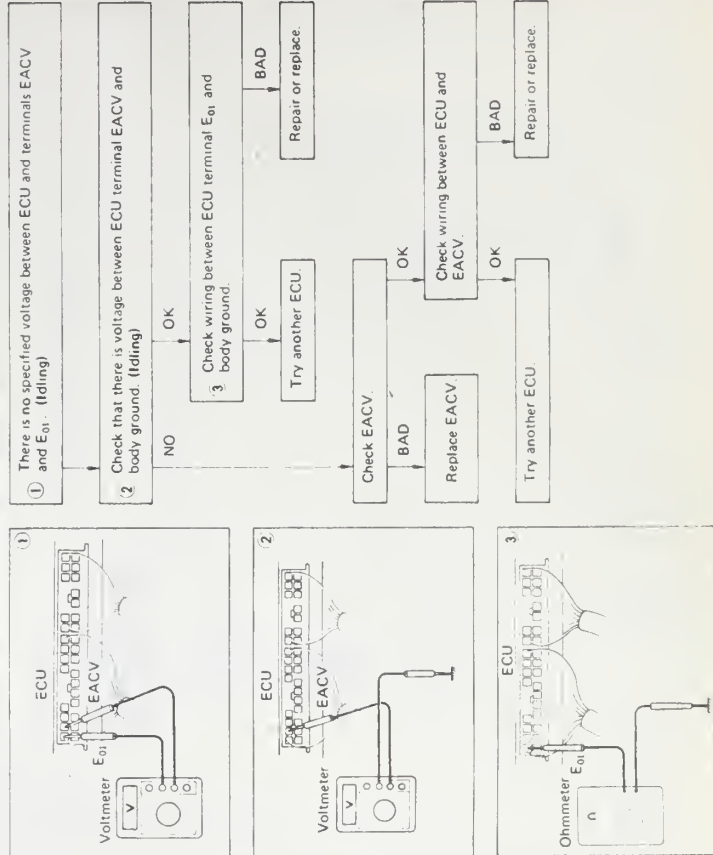
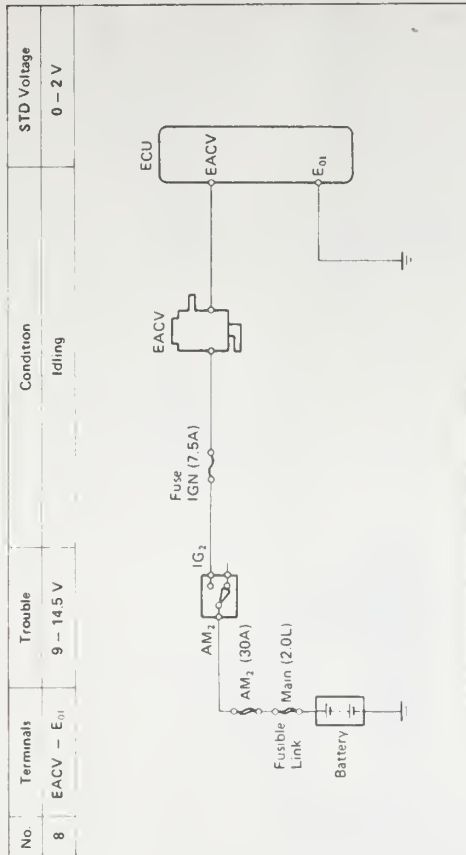
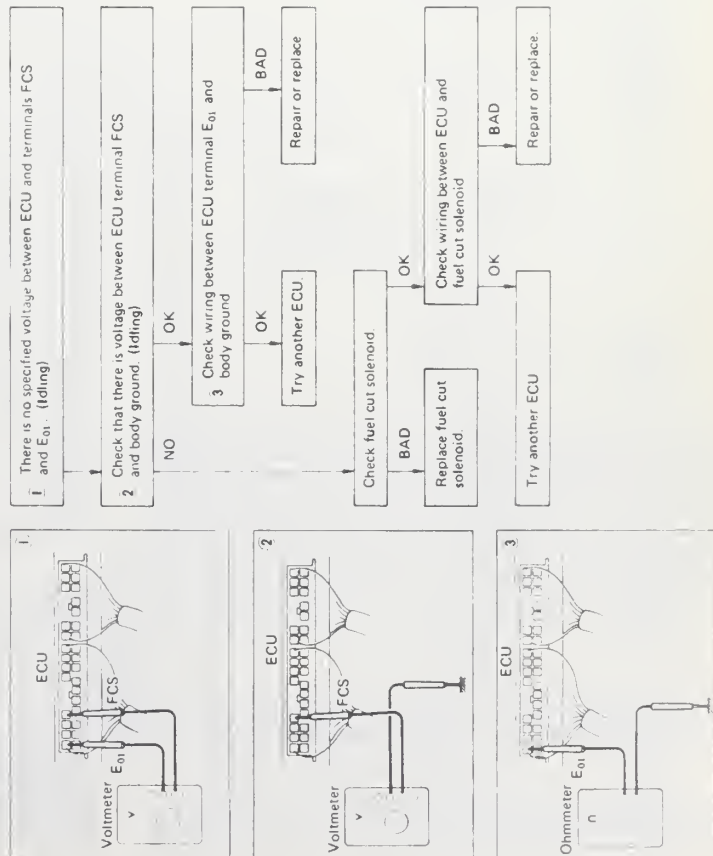
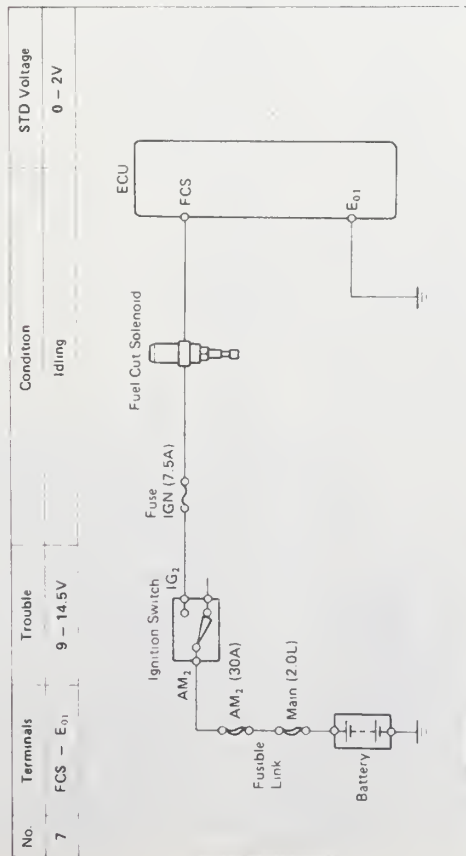


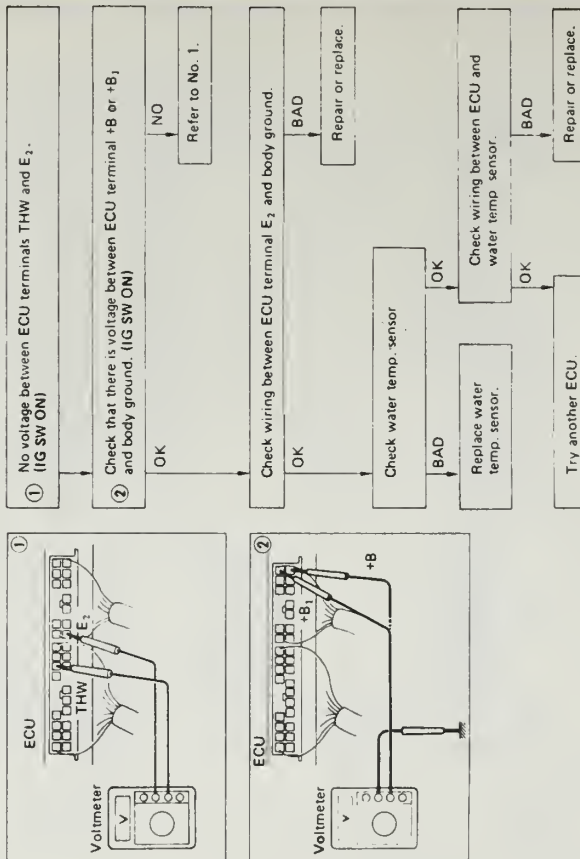
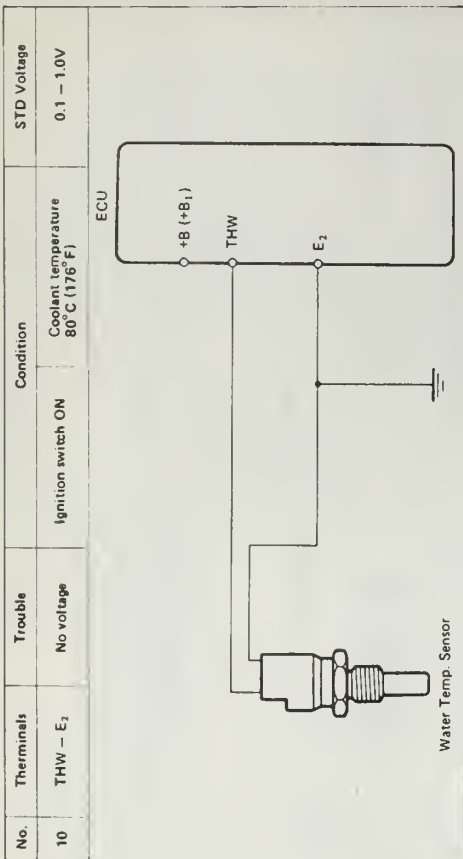
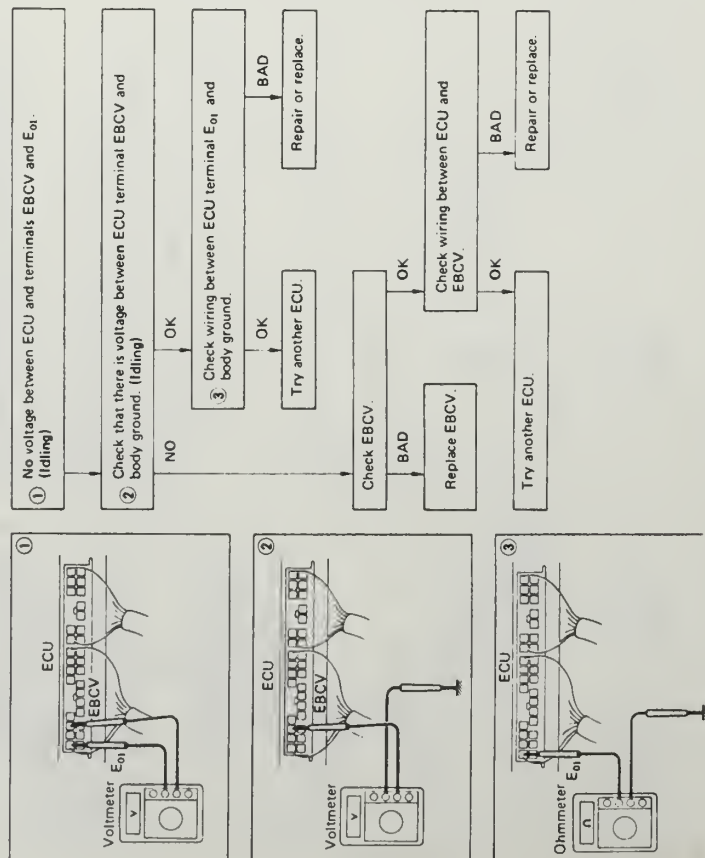
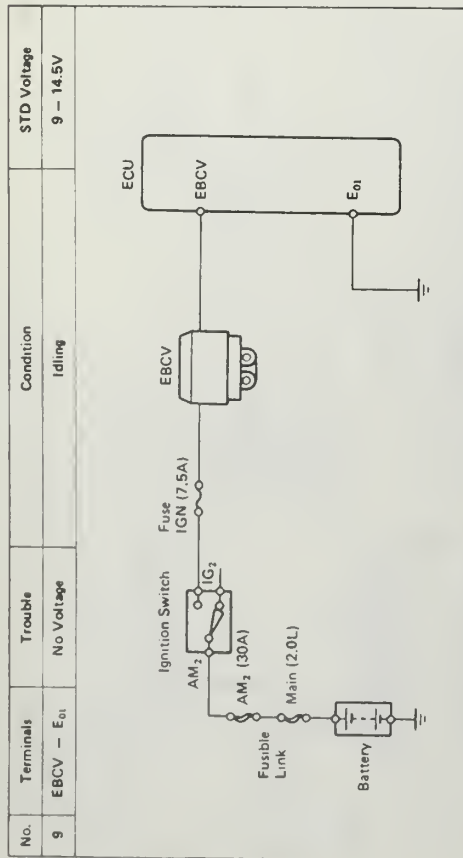
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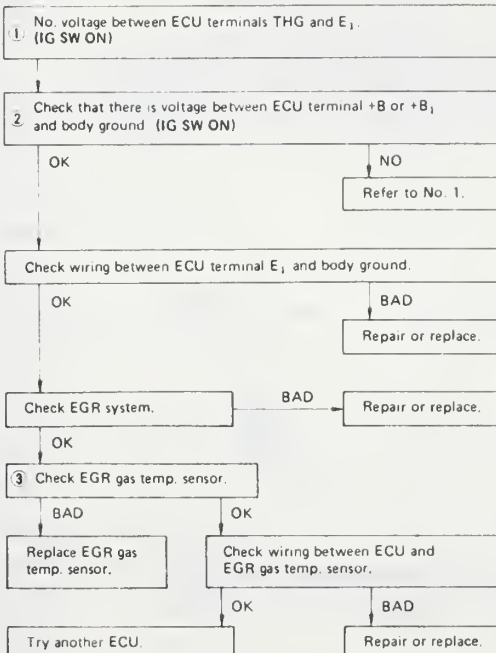
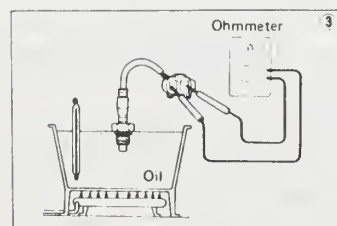
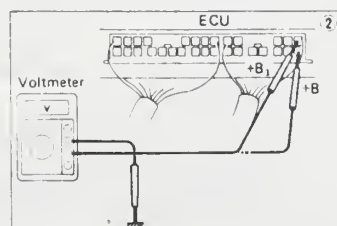
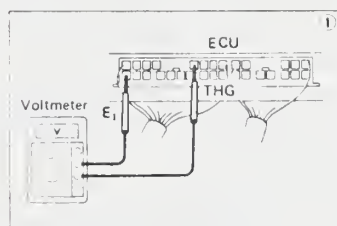
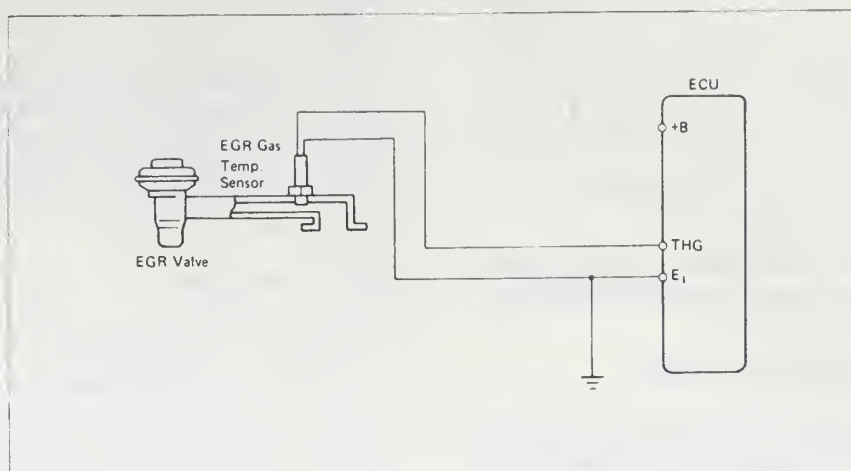
ECU TEST NO. 7 - 22R

ECU TEST NO. 8 - 22R





TESTING THE EGR GAS TEMPERATURE SENSOR — 22R



swap parts instead of performing a proper circuit diagnosis. To read fault codes:

1. The following initial conditions must be met:
 - a. Battery voltage at or above 11 volts.
 - b. Throttle fully closed—keep your foot off the accelerator
 - c. Transmission in N or neutral.
 - d. All electrical systems and accessories OFF.
2. Turn the ignition switch ON but do not start the engine.
3. Use the special jumper wire you made for tune-up work. Connect terminals TE1 and E1 of the check connector.
4. The fault codes will be transmitted through the controlled flashing of the CHECK ENGINE dash warning light.
5. If no malfunction was found or no code was stored, the lamp will flash 2 times per second with no other pauses or pattern. This is the system's way of confirming that its diagnostic system is working but has not detected anything abnormal. This normal operation signal should always be present if no other codes are stored.

6. The light will blink the number of the code(s). All codes are two digits; the pulsing of the light represents the digits, not the count. For example, Code 25 is displayed as two flashes, a 1½ second pause and five flashes. (Don't try to count 25 flashes.) If a more than one code is stored, the next will appear after a 2½ second pause. When all codes have been transmitted, there will be a 4½ second pause after which the entire string is repeated. The repeats will continue as long as both check connector terminals are connected.

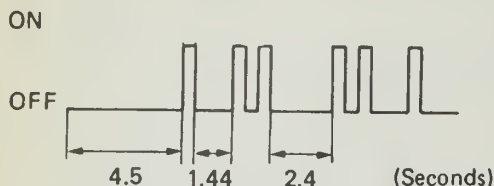
NOTE: If several codes are stored, they will be transmitted in numerical order from smallest to largest. This does NOT indicate the order of occurrence.

7. Always write down the codes.

8. After viewing the code(s) at least twice to confirm and record the correct numbers, remove the jumper from the check connector and turn the ignition OFF.

5 FUEL SYSTEM

Code No. 12 Code No. 21

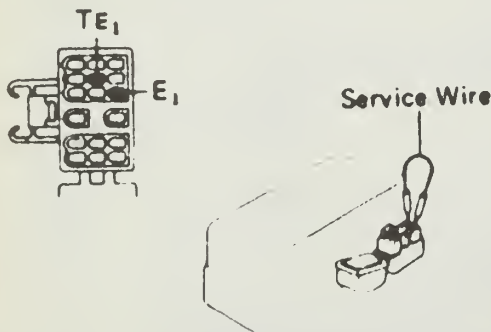


Examples of fault code transmission. Note the time spaces between numbers and groups of numbers

TROUBLESHOOTING

The troubleshooting procedures are designed to be performed with a volt-ohmmeter instead of expensive test equipment. There are procedures for checking each separate circuit or system, including the ability of the ECU to check itself.

NOTE: Some codes, particularly on 1991 vehicles, are noted as 2-trip detection codes. This simply means that the warning lamp on the dash will be lit on the second occurrence of the fault; the first occurrence is noted by the ECU but no further action is taken.



These terminals must be connected to read diagnostic codes for all fuel injected engines

Before beginning extended troubleshooting procedures, check the obvious first; look for blown fuses or links, loose connectors, chafed or pinched wiring, etc. Perform all tests with the connectors connected unless specifically directed to disconnect them.

WARNING: All tests **MUST** be performed with a high impedance digital volt/ohmmeter (DVOM). Meter impedance must be at least 10,000 Ω (10 k Ω) per volt. Lower impedance meters will damage the ECU and system components.

Use extreme care when probing connectors. Don't force the probes into the cavity and absolutely avoid any shorting be-

tween terminals. The ECU is extremely expensive and, being electronic, can be instantly and permanently damaged. You're working on your own vehicle to save money, not to cause more damage.

When testing at the ECU, it will be easier to remove the unit from its mount and gently (gently!) bring it as far into the passenger compartment as the harness will allow. This will allow more room to identify and probe terminals.

Note that these test procedures check the signals into and out of the ECU, usually at the ECU. Testing of individual components should be conducted by referring the appropriate test in this or other Sections of the book.

Safety Precautions

Working on or around electronic components introduces some risks not found on other systems. Parts of the system work at voltages much below the 12 volt battery voltage. Wires and connectors require virtually perfect contact for the system to transmit messages back and forth; check very carefully for any sign of corrosion or debris in the connector housings. Additionally, electronic systems use multi-pin connectors with as many as 25 pins. It is quite possible for all but one pin to make solid contact. Make certain the connectors are firmly and squarely attached and that no single pin is bent or pushed back in its mount. Some other rules are:

- Keep CB radios, car phones or ham equipment well away from the ECU. Route antenna cables on the opposite side of the vehicle. The ECU can be affected by radio frequency emissions from nearby sources.

- NEVER disconnect the battery while the engine is running.
- Never connect or disconnect any circuit connector with the ignition ON; the small voltage spike caused by the connection can destroy the ECU.

- Do not handle or move the ECU unless necessary for the job in progress hand. It can be damaged by minor impact or a static shock from your fingers.

- When testing at the terminals, be extremely conscious of the polarity of the test leads; introducing voltage into the wrong circuit can teach an expensive lesson.

- Use thin probes on test meters; large, blunt probes can damage or deform terminals. Large probes may also short to an adjoining pin.

- Remember that electricity travels just below the speed of light; you will not get a second chance if a circuit is connected improperly. Damage is instantaneous, permanent and not always obvious.

- When working on the vehicle, do not allow power cords for welders, drop lights or power tools to lie on, near or across wiring to the ECU. AC current can induce current flow in the automotive wiring.

- Keep everything dry; moisture in a connector can cause shorting and/or corrosion.

- If a waterproof cover must be removed to test a terminal, always replace it as it was. Never poke a probe through a cover.

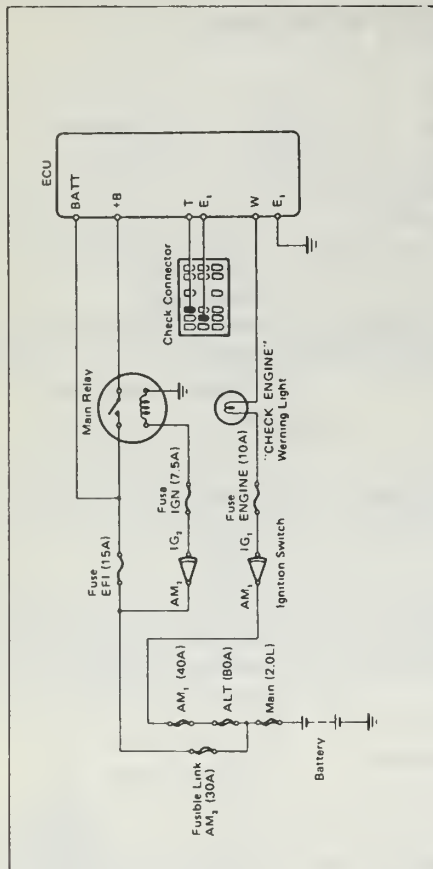
- Pay attention. Some wire color markers look very much alike in low light. If in doubt, have an assistant double check for you or get better lighting.

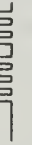
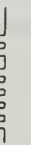
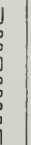
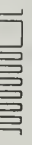
- If any wire repair is needed, the splice must be absolutely equal to the rest of the wire. A poor splice introduces resistance which can affect signal transmission. Soldering is recommended at any splice, but only with the ECU connector disconnected from the unit.

FAULT CODES: 1989-90 VEHICLES WITH 22R-E

Code No.	Number of blinks "CHECK ENGINE"	System	Diagnosis	Trouble area
—		Normal	This appears when none of the other codes are identified.	_____
12		RPM Signal	NO "Ne" signal to ECV within 2 seconds after engine has been cranked.	• Distributor circuit • Distributor • Igniter circuit • Igniter • Starter signal circuit • ECU
13		RPM Signal	NO "Ne" signal to ECU when engine speed is above 1,500 rpm.	• Distributor circuit • Distributor • Igniter circuit • Igniter • ECU
14		Ignition Signal	NO "IGf" signal to ECU 4 – 5 times in succession.	• Igniter and ignition coil circuit • Igniter and ignition coil • ECU
21		Main Oxygen Sensor	• Detection of oxygen sensor deterioration.	• Oxygen sensor circuit • Oxygen sensor • ECU
		Main Oxygen Sensor Heater	• Open or short circuit in oxygen sensor heater.	• Oxygen sensor heater circuit • Oxygen sensor heater • ECU
22		Water Temp. Sensor Signal	• Open or short circuit in water temp. sensor signal.	• Water temp. sensor circuit • Water temp. sensor • ECU
24		Intake Air Temp. Sensor Signal	• Open or short circuit in intake air temp. sensor signal.	• Intake air temp. sensor circuit • Intake air temp. sensor • ECU
25		• Air-fuel Ratio Lean Malfunction • Oxygen Sensor	• When oxygen sensor signal continues at the upper (rich) or lower (lean) limit for a certain period of time during feedback condition. • When air-fuel ratio feedback compensation value or adaptive control value continues at the upper (lean) or lower (rich) limit renewed for a certain period of time. • Open or short circuit in oxygen sensor.	• Injector circuit • Injector • Fuel line pressure • Oxygen sensor circuit • Oxygen sensor • Air flow meter • Air intake system • ECU
26		• Air-fuel Ratio Rich Malfunction (Federal and Canada) • Oxygen Sensor	• Open or short circuit in oxygen sensor.	• Injector circuit • Injector • Fuel line pressure • Air-flow meter • Cold start injector • ECU (Federal and Canada) • Oxygen sensor circuit • Oxygen sensor

**FAULT CODES: 1989-90 VEHICLES WITH
22R-E (CONTINUED)**



Code No.	Number of blinks "CHECK ENGINE" (California only)	System	Diagnosis	Trouble area
27		Sub Oxygen Sensor	• Detection of oxygen sensor deterioration.	• Oxygen sensor circuit • Oxygen sensor • ECU
31		Sub Oxygen Sensor Heater	• Open or short circuit in oxygen sensor heater.	• Oxygen sensor heater circuit • Oxygen sensor heater • ECU
41		Air flow Meter Signal	• Short circuit between VC and VB, VC and E₂, or VS and VC. • Open circuit between VC and E₂.	• Air flow meter circuit • Air flow meter
42		Throttle Position Sensor Signal	• Open or short circuit in throttle position sensor signal.	• Throttle position sensor circuit • Throttle position sensor
43		Vehicle Speed Sensor Signal	• NO "SPD" signal for 5 seconds when engine speed is above 2,500 rpm.	• Vehicle speed sensor circuit • Vehicle speed sensor • ECU
52		Starter Signal	• NO "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moving.	• IG switch circuit • IG switch • ECU
53		Knock Sensor Signal	• Open or short circuit in knock sensor signal.	• Knock sensor circuit • Knock sensor • ECU
71		Knock Control Signal in ECU	• Knock control in ECU faulty.	• ECU
51		EGR System Malfunction	• EGR gas temp. below pre-determined level during EGR operation.	• EGR valve • EGR hose • EGR gas temp. sensor circuit • EGR gas temp. sensor • VSV for EGR circuit • ECU
51		Switch Signal	• No "IDL" signal or No "NSW" signal or "A/C" signal to ECU, with the check connector E₁ and TE₁ shorted.	• A/C switch circuit • A/C switch • A/C Amplifier • Throttle position sensor circuit • Throttle position sensor • (A/T) • Neutral start switch circuit • (A/T) • Neutral start switch • ECU

- ```

graph TD
 Start([START]) --> Step1_1[Does CHECK ENG. light come on when ignition switch is at ON?]
 Step1_1 -- NO --> Step1_2[System Normal]
 Step1_1 -- YES --> Step1_3[Does CHECK ENG. light come on when ECU terminal W is grounded to the body?]
 Step1_3 -- NO --> Step1_4[Check bulb, fuse and wiring between ECU and ignition switch.]
 Step1_4 -- BAD --> Step1_5[Repair or replace.]
 Step1_3 -- YES --> Step1_6[Check wiring between ECU terminal E1 and body ground.]
 Step1_6 -- BAD --> Step1_5
 Step1_6 -- OK --> Step1_7[Try another ECU.]
 Step1_7 --> Step2_1[Does CHECK ENG. light go OFF when engine is started?]
 Step2_1 -- YES --> Step2_2[System Normal]
 Step2_1 -- NO --> Step2_3[Check wiring between ECU and CHECK ENG. light.]
 Step2_3 -- OK --> Step2_4[Is there diagnosis code output when check connector TE1 and E1 is connect circuited?]
 Step2_4 -- YES --> Step2_5[Does CHECK ENG. light go out after repair according to malfunction code?]
 Step2_5 -- YES --> Step2_6[System OK]
 Step2_5 -- NO --> Step2_7[Further repair required]
 Step2_7 --> Step2_8[Cancel out diagnostic code.]
 Step2_4 -- NO --> Step2_9[Try another ECU.]
 Step2_3 -- BAD --> Step2_10[Repair]

```

# ECU TERMINALS: 1989-90 VEHICLES WITH 22R-E, EXCEPT 4WD WITH AUTOMATIC TRANSMISSION

| Symbol          | Terminal Name               | Symbol             | Terminal Name              |
|-----------------|-----------------------------|--------------------|----------------------------|
| E <sub>01</sub> | ENGINE GROUND               | *1 O <sub>x2</sub> | OXYGEN SENSOR (SUB)        |
| E <sub>02</sub> | ENGINE GROUND               | O <sub>x1</sub>    | OXYGEN SENSOR (MAIN)       |
| No. 10          | INJECTOR                    | *1 THG             | EGR GAS TEMP. SENSOR       |
| No. 20          | INJECTOR                    | Vcc                | THROTTLE POSITION SENSOR   |
| STA             | STARTER SWITCH              | KNK                | KNOCK SENSOR               |
| IGt             | IGNITER                     | VTA                | THROTTLE POSITION SENSOR   |
| STJ             | COLD START INJECTOR         | Ne                 | DISTRIBUTOR                |
| E <sub>1</sub>  | ENGINE GROUND               | THW                | WATER TEMP. SENSOR         |
| NSW             | NEUTRAL START SWITCH        | *1 HT <sub>2</sub> | OXYGEN SENSOR HEATER (SUB) |
| VF              | CHECK CONNECTOR             | *2 ECT             | OD RELAY                   |
| Fpu             | FUEL PRESSURE UP VSV        | Vc                 | AIR FLOW METER             |
| ACV             | A/C IDLE UP VSV             | E <sub>31</sub>    | SENSOR GROUND              |
| W               | CHECK ENGINE WARNING LIGHT  | V <sub>2</sub>     | AIR FLOW METER             |
| AS              | AS VSV                      | *3 4WD             | 4WD SWITCH                 |
| T               | CHECK CONNECTOR             | THA                | AIR TEMP. SENSOR           |
| *1 EGR          | THROTTLE POSITION SENSOR    | SPD                | SPEED SENSOR               |
| IDL             | THROTTLE POSITION SENSOR    | BATT               | BATTERY +B                 |
| HT <sub>1</sub> | OXYGEN SENSOR HEATER (MAIN) | STP                | STOP LIGHT SWITCH          |
| IGf             | IGNITER                     | *B <sub>1</sub>    | MAIN RELAY                 |
| E <sub>2</sub>  | SENSOR GROUND               | +B                 | MAIN RELAY                 |

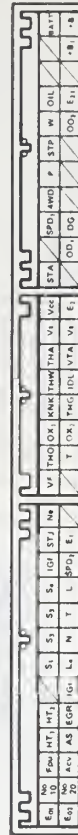
\*1: California only    \*2: A/T only    \*3: 4WD only



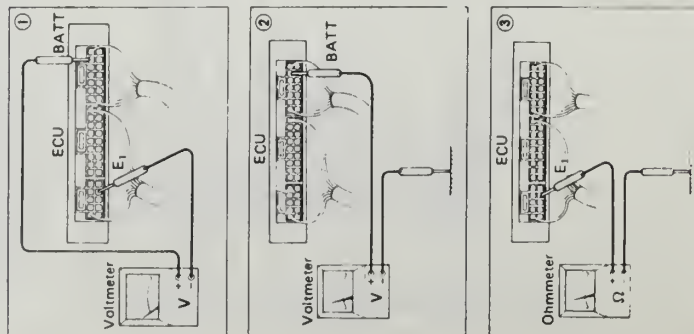
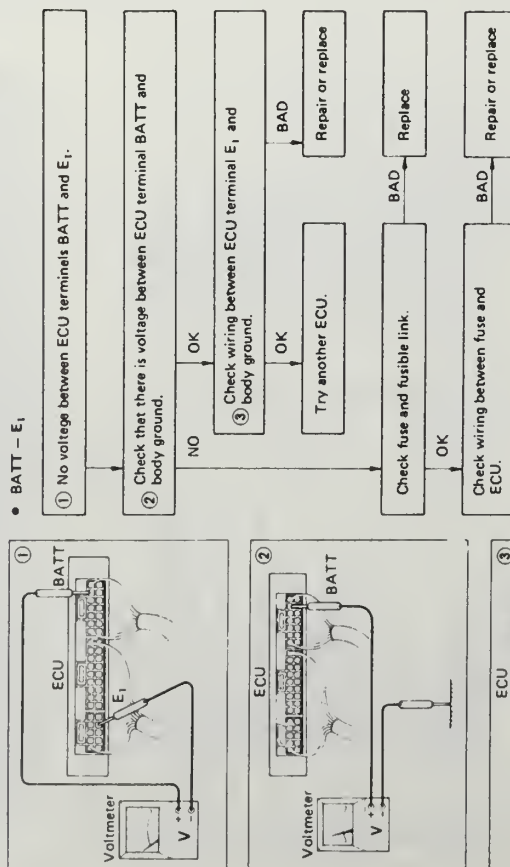
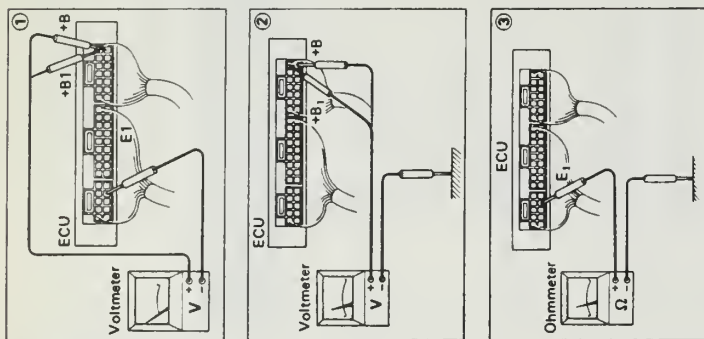
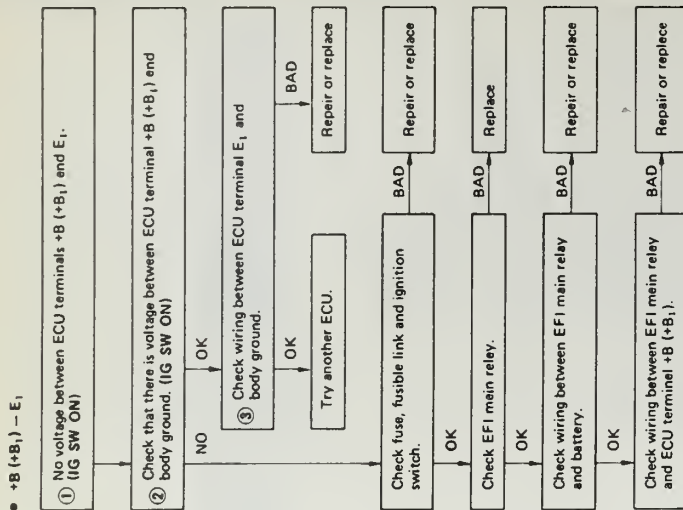
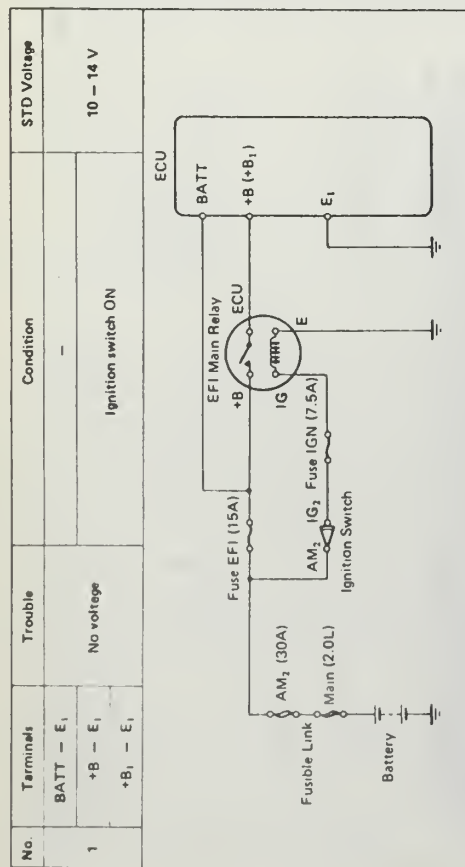
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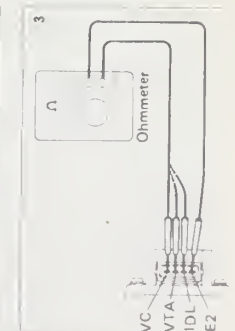
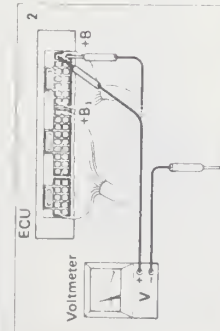
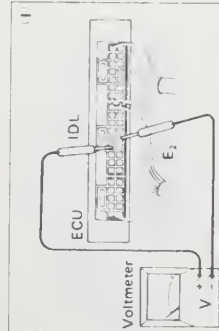
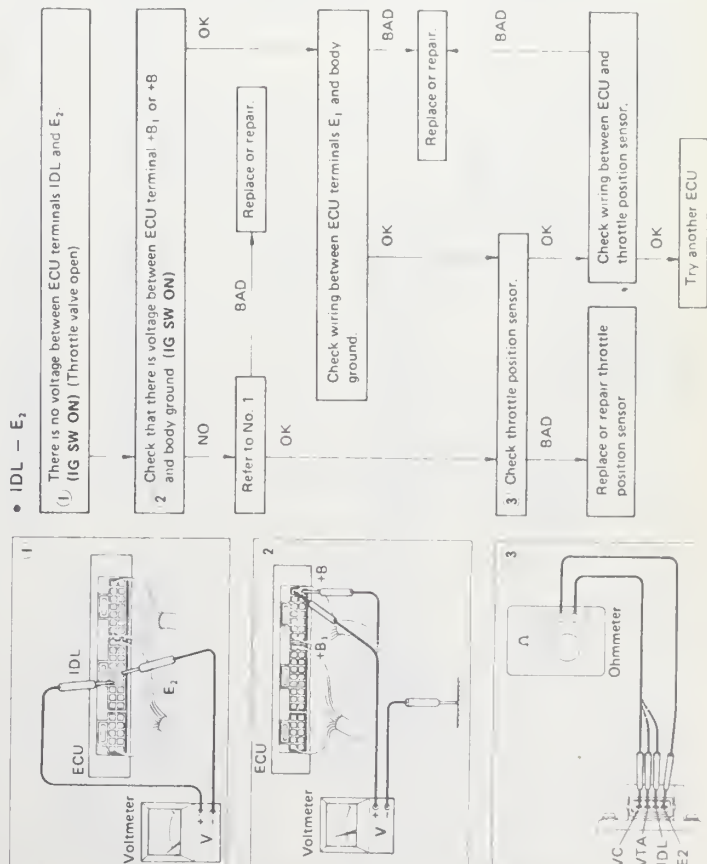
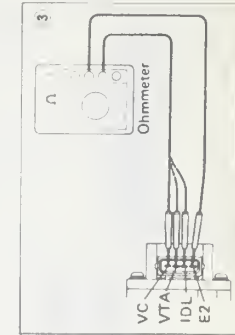
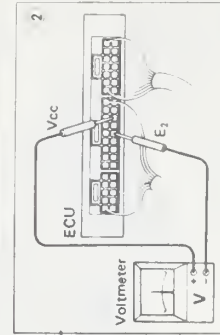
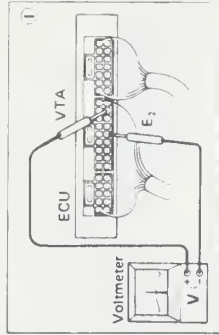
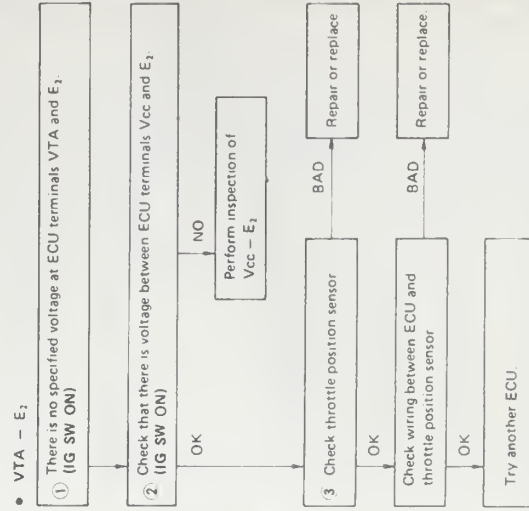
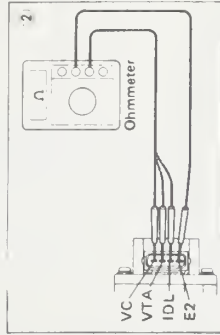
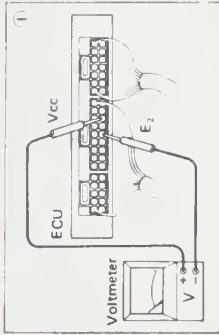
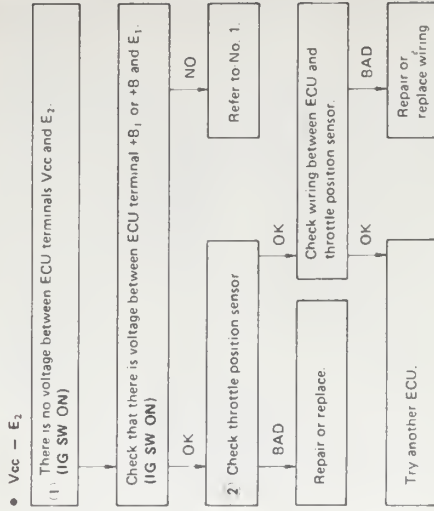
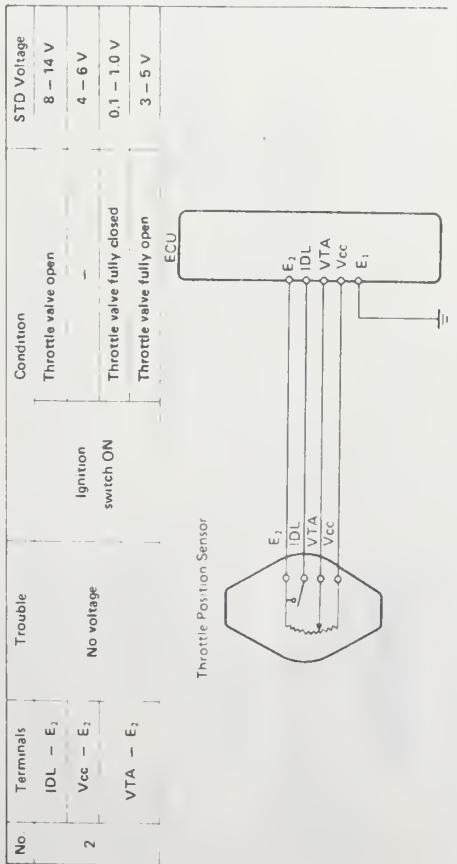
| Symbol            | Terminal Name               | Symbol            | Terminal Name               |
|-------------------|-----------------------------|-------------------|-----------------------------|
| E <sub>01</sub>   | ENGINE GROUND               | O <sub>x1</sub>   | OXYGEN SENSOR (MAIN)        |
| E <sub>02</sub>   | ENGINE GROUND               | * O <sub>x2</sub> | OXYGEN SENSOR (SUB)         |
| No. 10            | INJECTOR                    | KNK               | KNOCK SENSOR                |
| No. 20            | INJECTOR                    | * THG             | EGR GAS TEMP. SENSOR        |
| Fpu               | FUEL PRESSURE UP VSV        | THW               | WATER TEMP. SENSOR          |
| ACV               | A/C IDLE UP VSV             | IDL               | THROTTLE POSITION SENSOR    |
| HT <sub>1</sub>   | OXYGEN SENSOR HEATER (MAIN) | THA               | AIR TEMP. SENSOR            |
| AS                | AS VSV                      | VTA               | THROTTLE POSITION SENSOR    |
| * HT <sub>2</sub> | OXYGEN SENSOR HEATER (SUB)  | Vc                | AIR FLOW METER              |
| * EGR             | EGR VSV                     | V <sub>2</sub>    | AIR FLOW METER              |
| IGt               | IGNITER                     | Vcc               | THROTTLE POSITION SENSOR    |
| S <sub>1</sub>    | ECT SOLENOID                | E <sub>2</sub>    | SENSOR GROUND               |
| L <sub>4</sub>    | TRANSFER POSITION SWITCH    | STA               | STARTER SWITCH              |
| S <sub>2</sub>    | ECT SOLENOID                | OD <sub>1</sub>   | CRUISE CONTROL COMPUTER     |
| N                 | NEUTRAL START SWITCH        | SPD <sub>1</sub>  | SPEED SENSOR                |
| S <sub>3</sub>    | ECT SOLENOID                | DG                | CHECK CONNECTOR             |
| 2                 | NEUTRAL START SWITCH        | 4WD               | 4WD SWITCH                  |
| S <sub>4</sub>    | ECT SOLENOID                | P                 | PATTERN SELECT SWITCH       |
| L                 | NEUTRAL START SWITCH        | STP               | STOP LIGHT SWITCH           |
| IGf               | IGNITER                     | W                 | CHECK ENGINE WARNING LIGHT  |
| SPD <sub>2</sub>  | SPEED SENSOR                | OD <sub>2</sub>   | CRUISE CONTROL COMPUTER     |
| STJ               | COLD START INJECTOR         | OIL               | A/T OIL TEMP. WARNING LIGHT |
| E <sub>1</sub>    | ENGINE GROUND               | E <sub>21</sub>   | SENSOR GROUND *             |
| Ne                | DISTRIBUTOR                 | +B <sub>1</sub>   | MAIN RELAY                  |
| VF                | CHECK CONNECTOR             | BATT              | BATTERY +B                  |
| THO               | T/M OIL TEMP. SENSOR        | +B                | MAIN RELAY                  |
| T                 | CHECK CONNECTOR             |                   |                             |

\*: California only





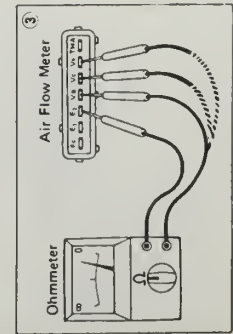
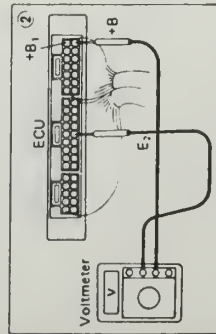
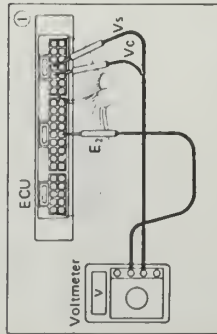
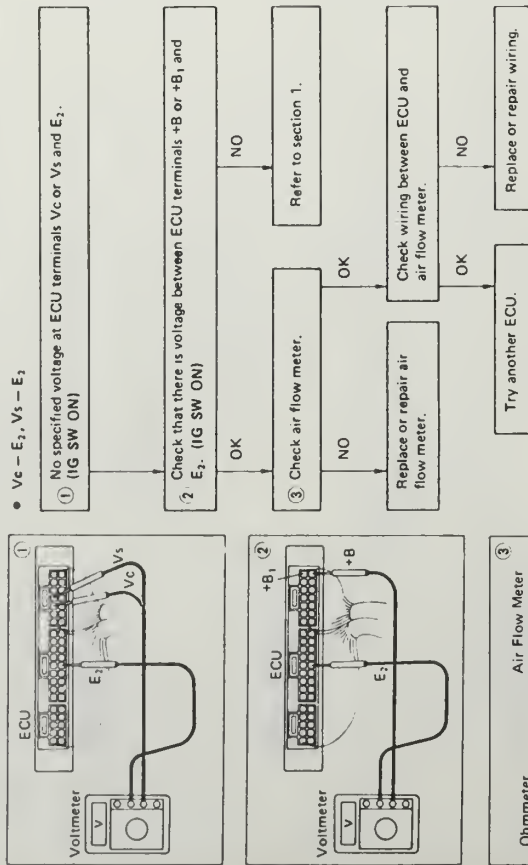
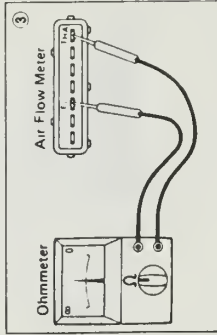
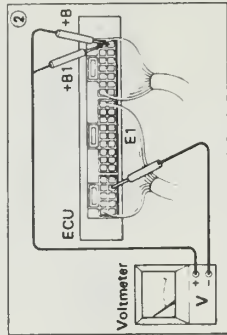
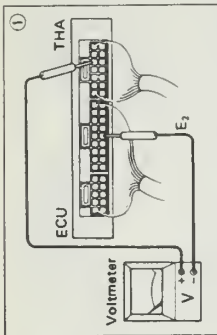
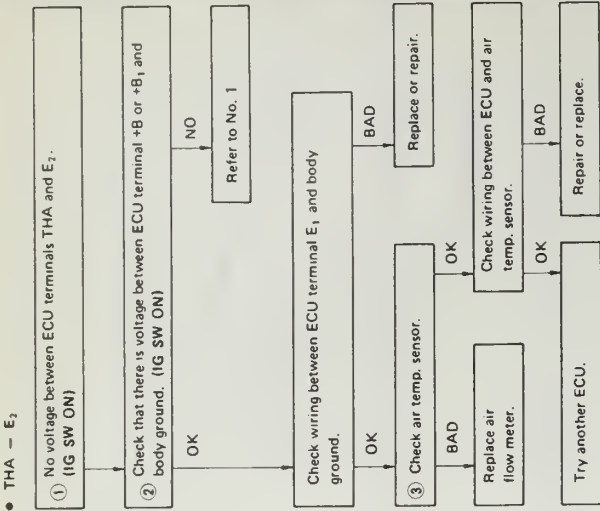


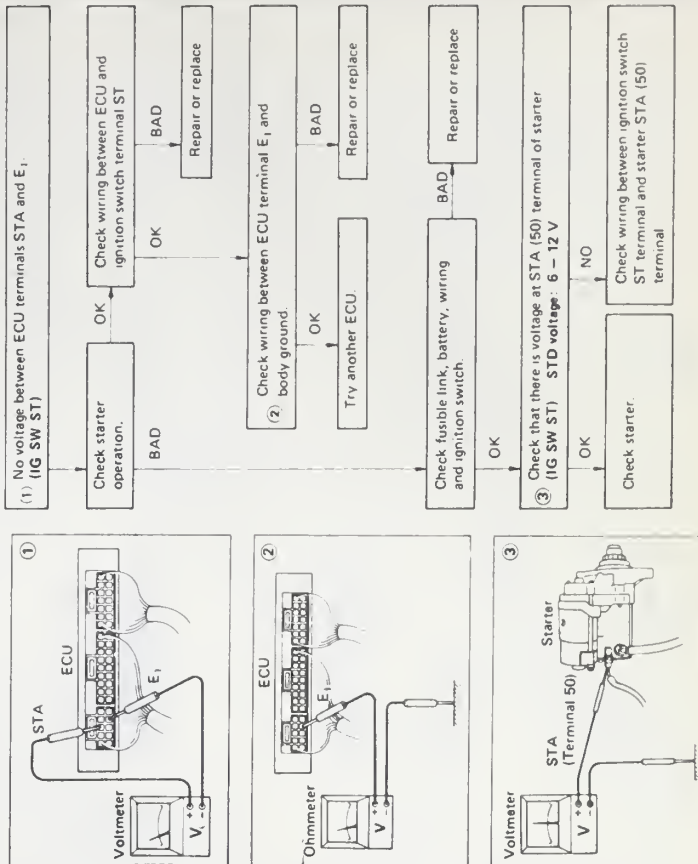
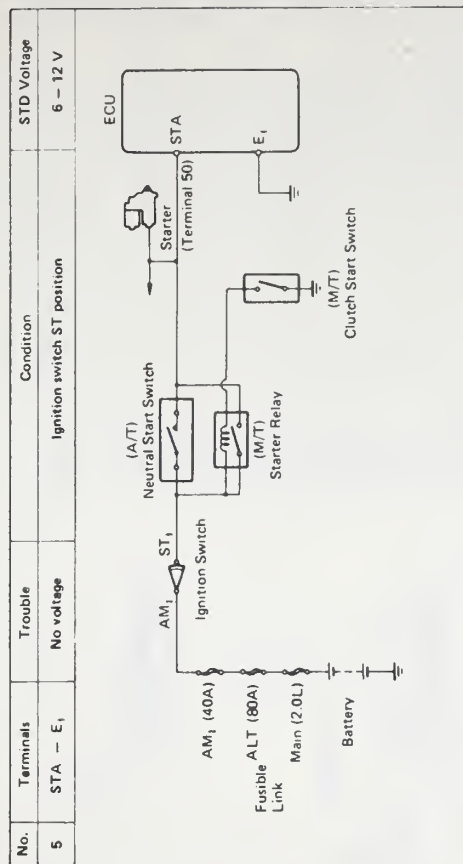
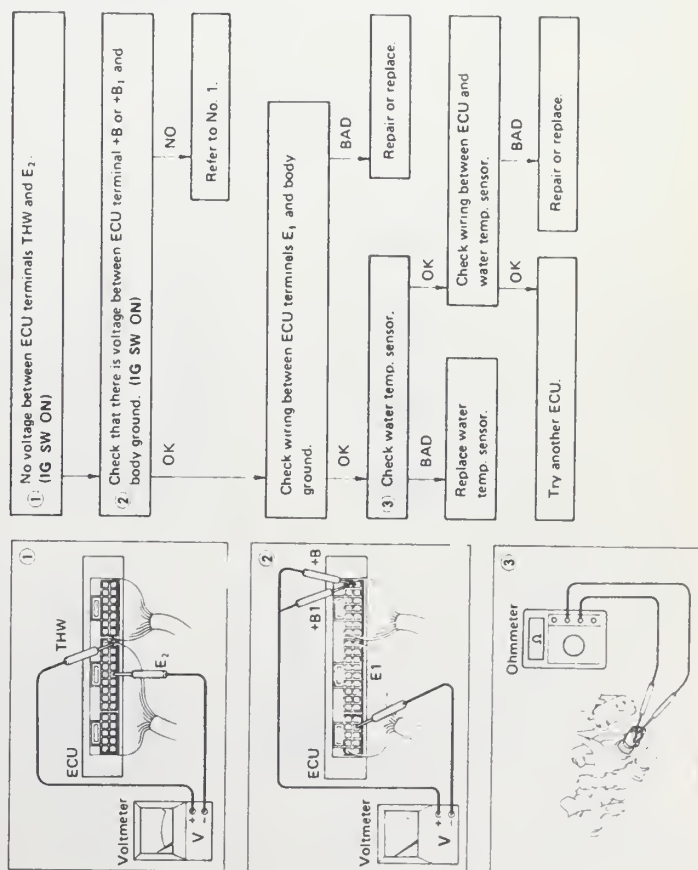
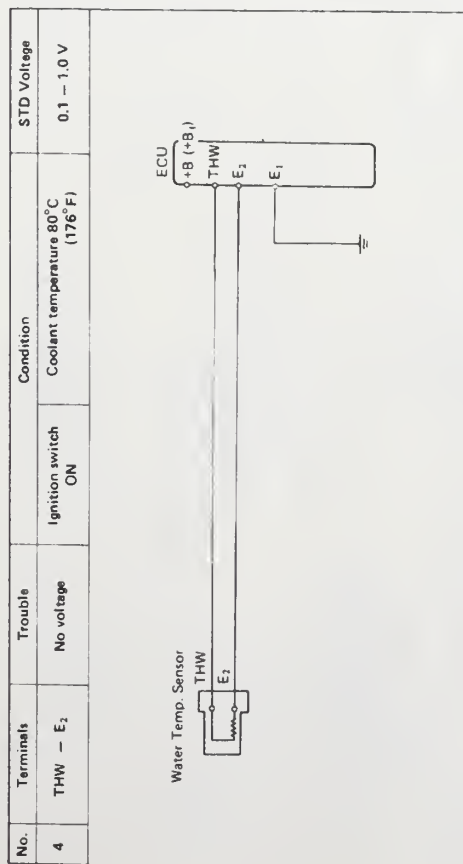




# 5 FUEL SYSTEM

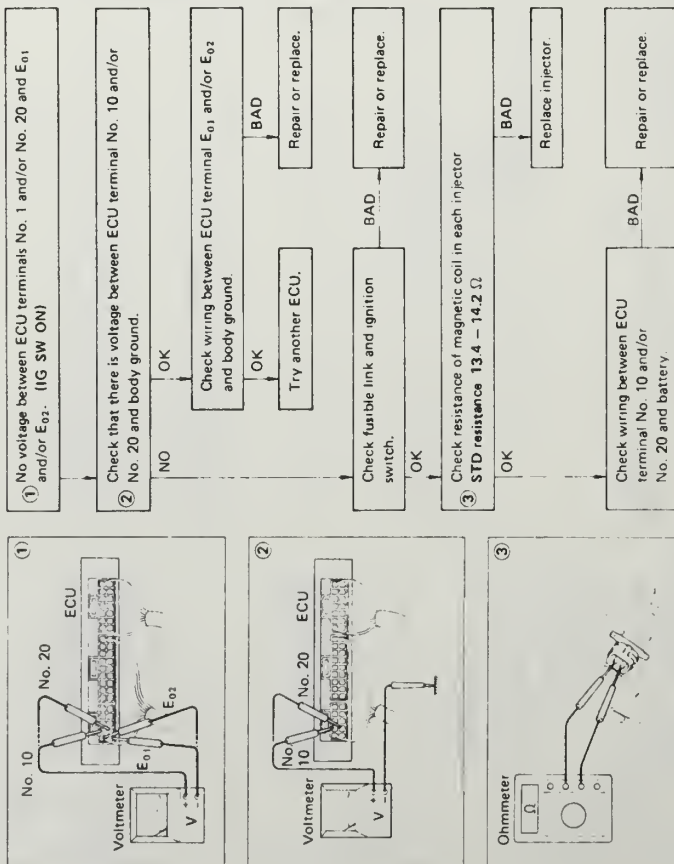
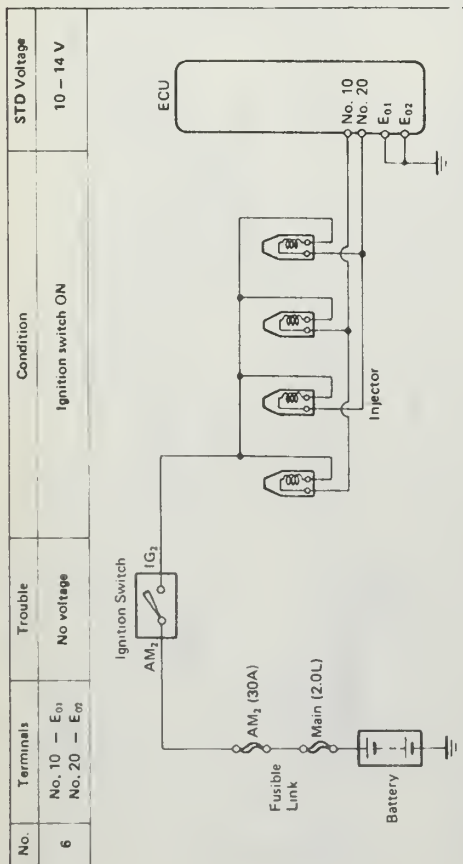
| No. | Terminals                       | Trouble    | Condition                          | STD Voltage |
|-----|---------------------------------|------------|------------------------------------|-------------|
| 3   | Vc - E <sub>2</sub>             | No voltage | Ignition switch ON                 | 6 - 10 V    |
|     | V <sub>s</sub> - E <sub>2</sub> |            | Measuring plate fully closed       | 3.7 - 4.3 V |
|     |                                 |            | Measuring plate fully open         | 0.2 - 0.5 V |
|     | THA - E <sub>2</sub>            |            | Idling                             | 2.3 - 2.8 V |
|     |                                 |            | Intake air temperature 20°C (68°F) | 1 - 3 V     |

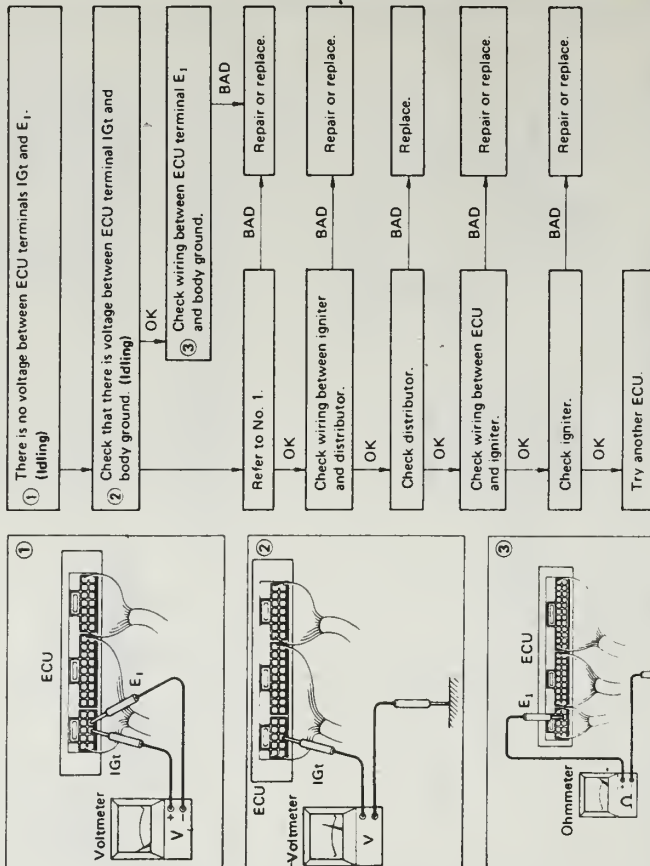
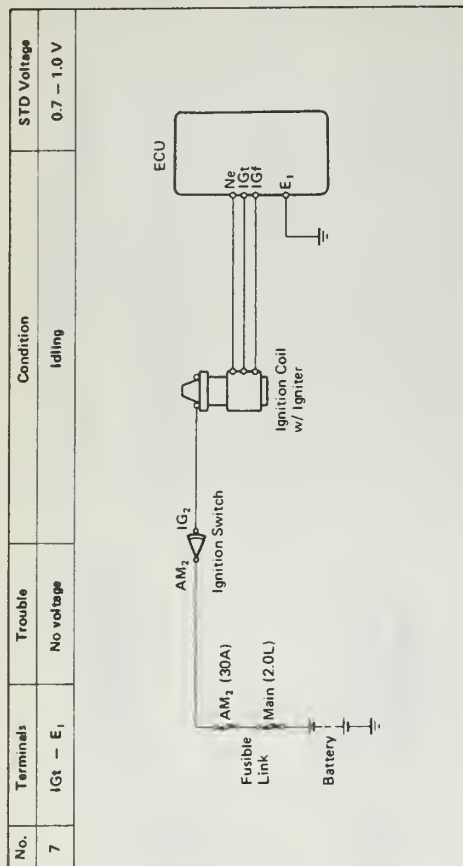




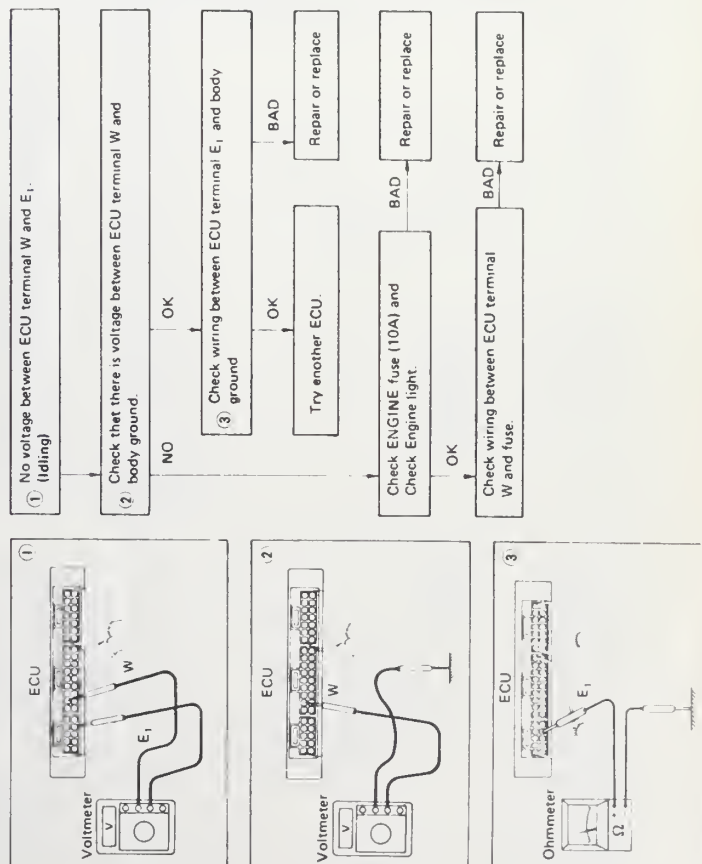
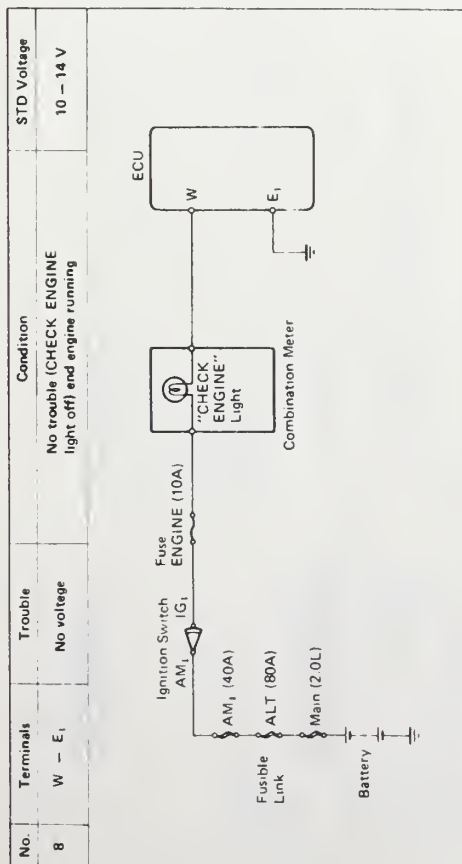
# ECU TEST NO. 6: 1989-90 VEHICLES WITH 22R-E EXC. 4WD W/AUTO. TRANS



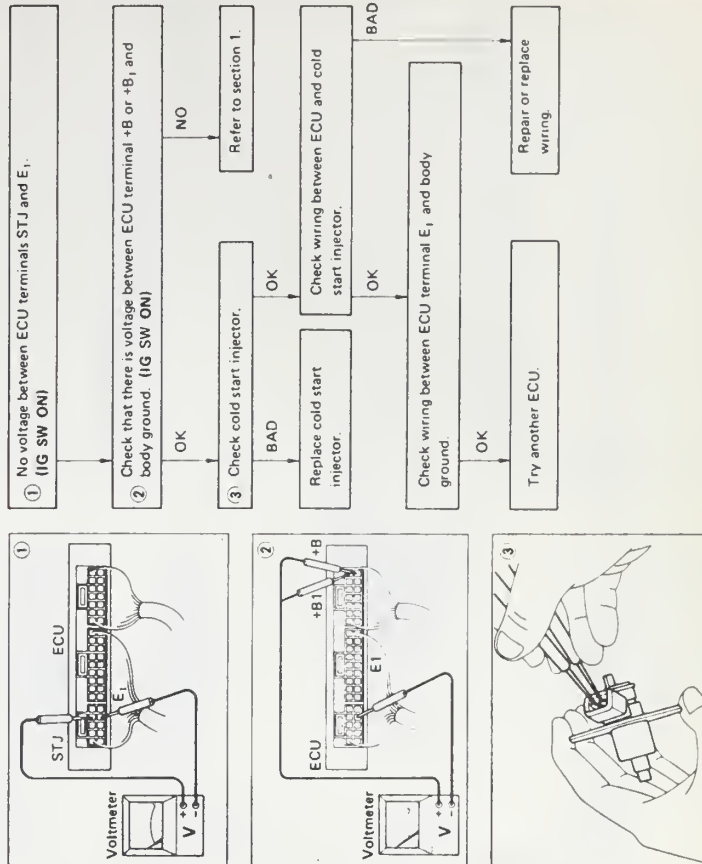
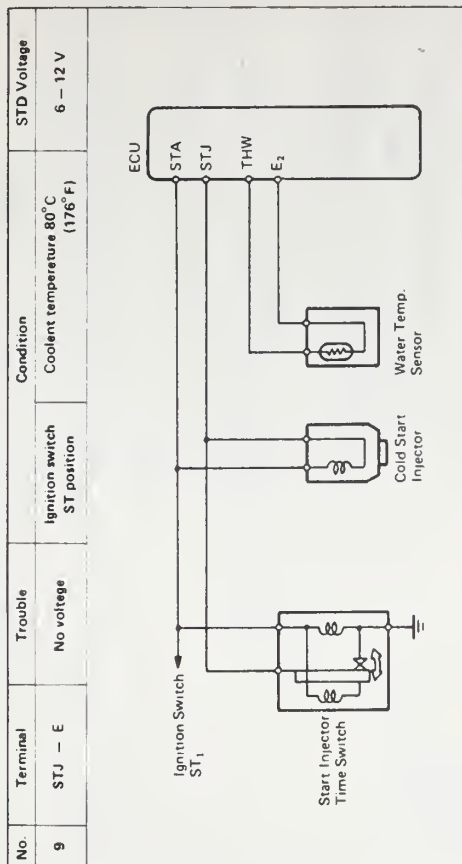
# ECU TEST NO. 7: 1989-90 VEHICLES WITH 22R-E EXC. 4WD W/AUTO. TRANS



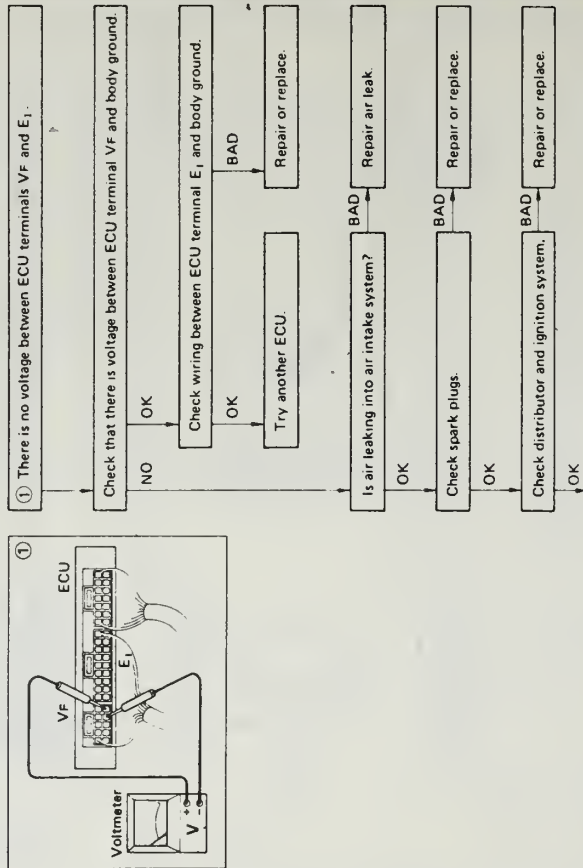
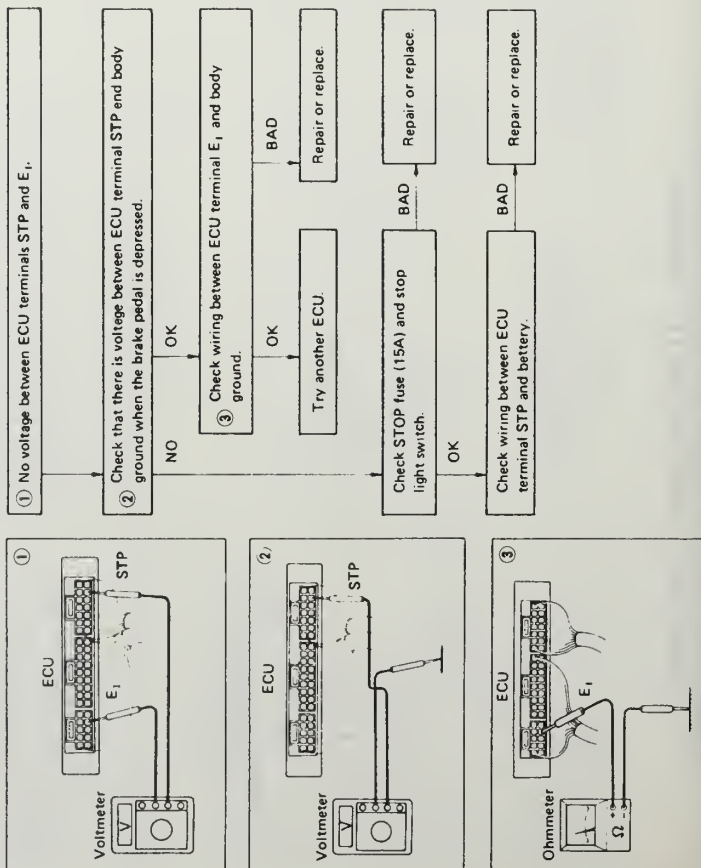
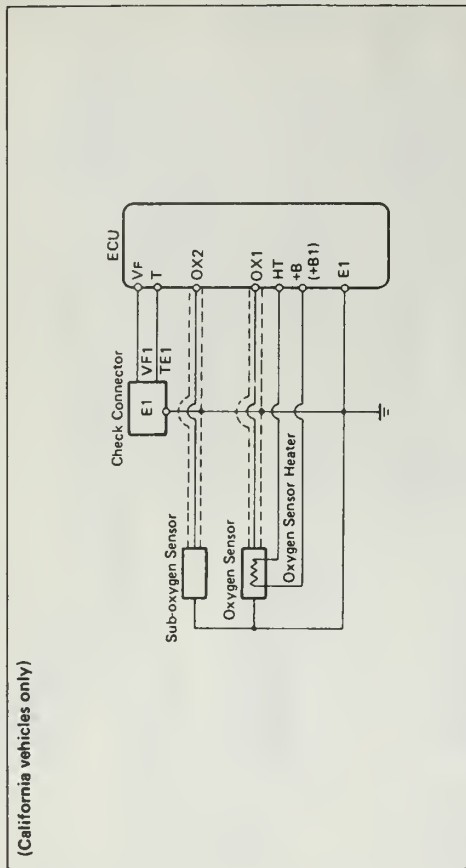
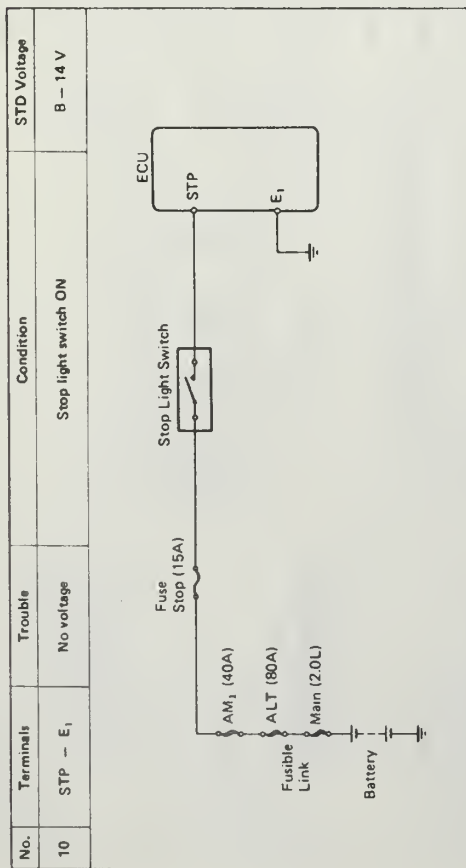
# ECU TEST NO. 8: 1989-90 VEHICLES WITH 22R-E EXC. 4WD W/AUTO. TRANS



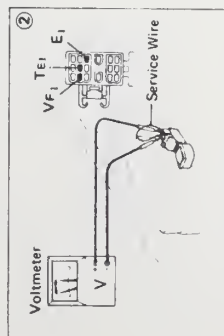
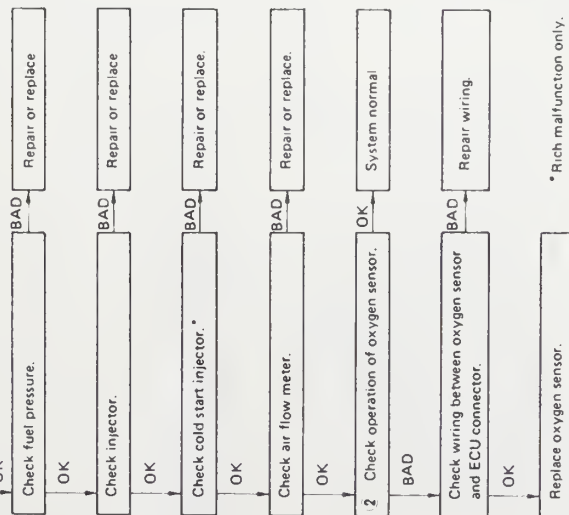
# ECU TEST NO. 9: 1989-90 VEHICLES WITH 22R-E EXC. 4WD W/AUTO. TRANS



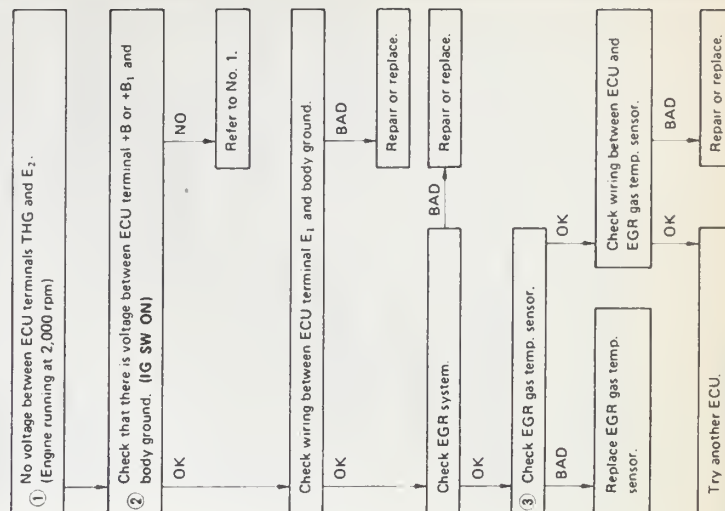
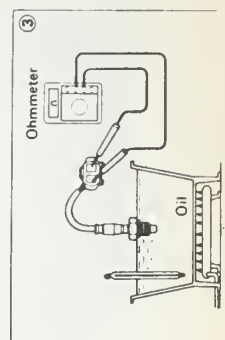
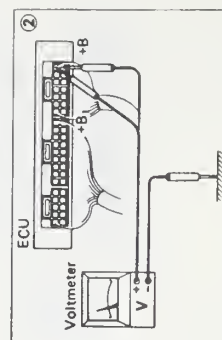
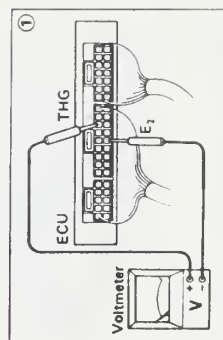
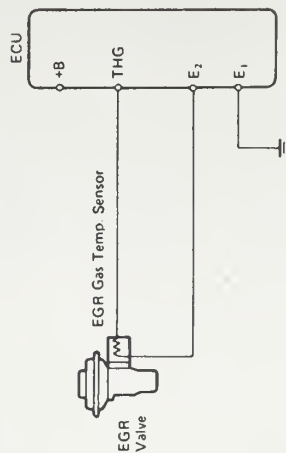




CONTINUED

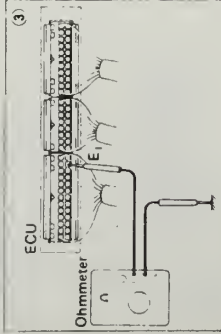
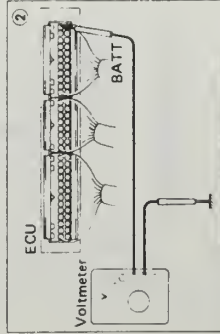
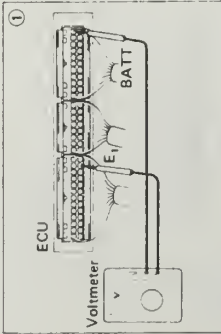
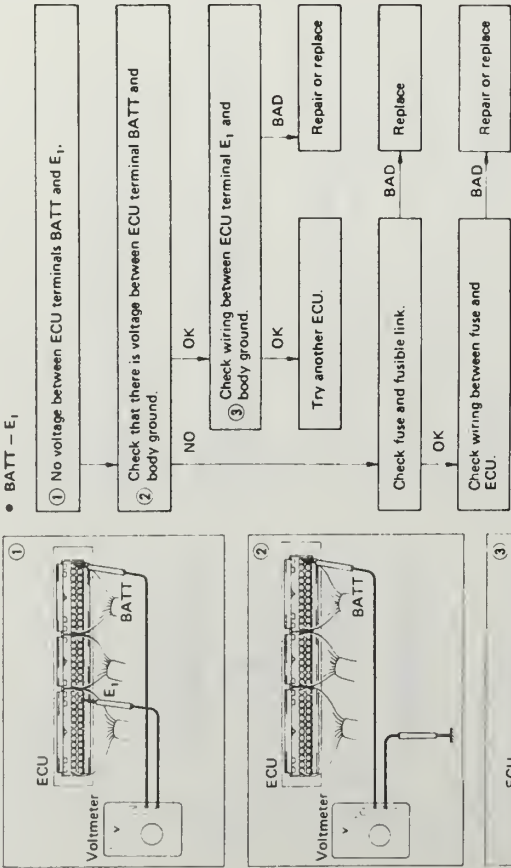
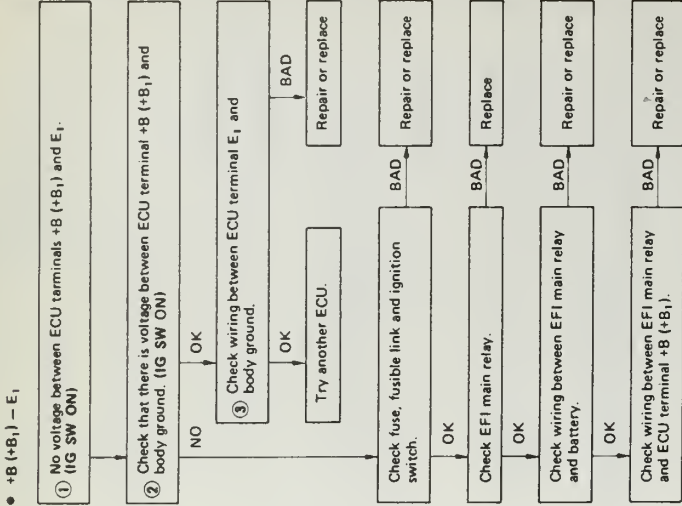
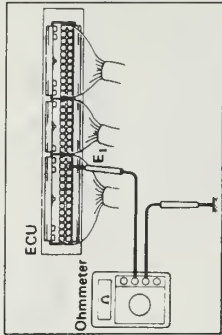
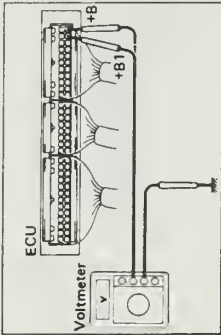
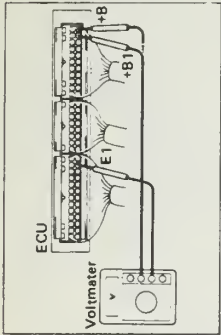
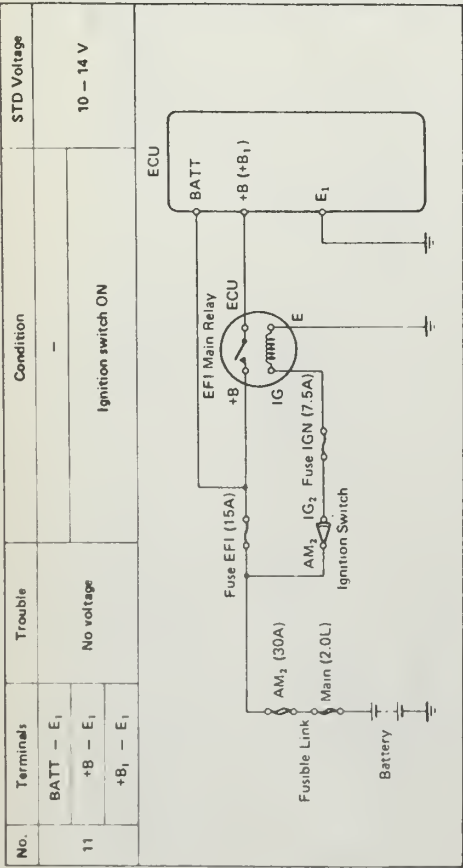


(California only)



\* Rich malfunction only.

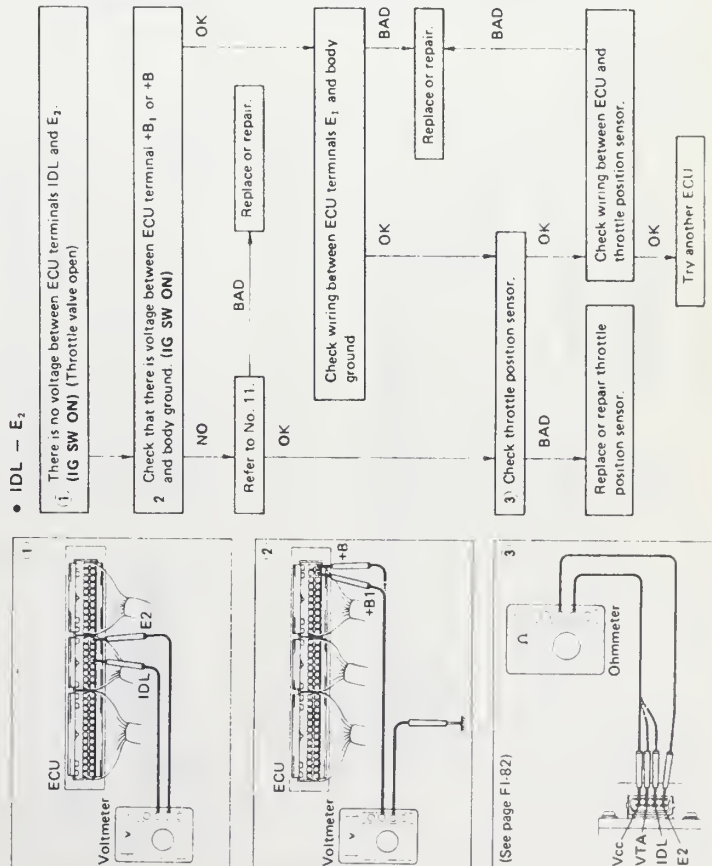
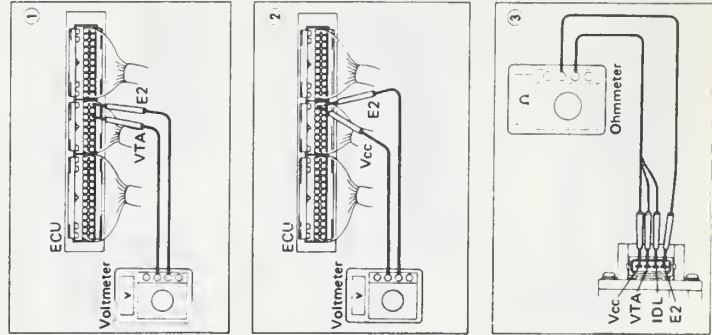
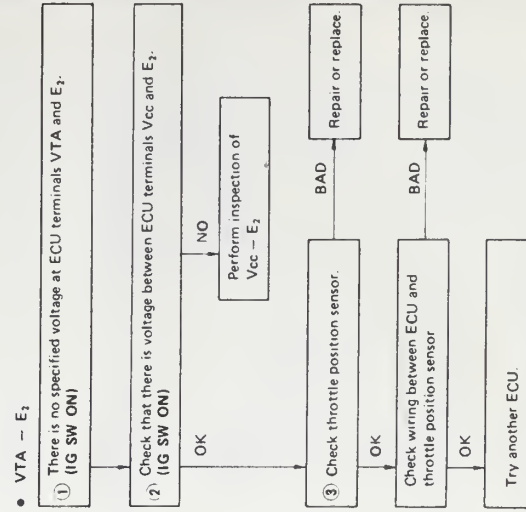
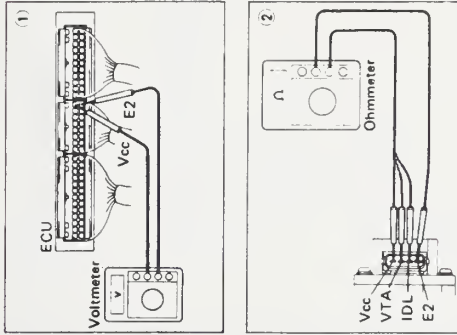
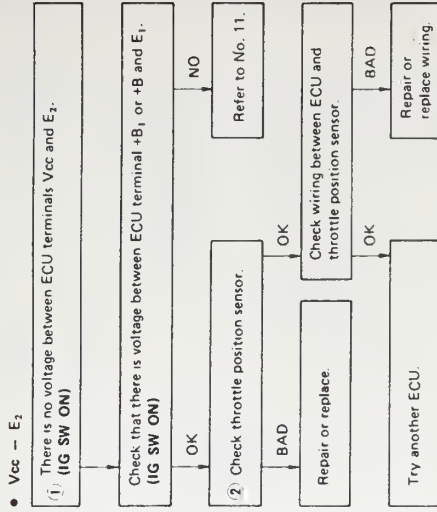




| No. | Terminals            | Trouble    | Condition                                                | STD Voltage            |
|-----|----------------------|------------|----------------------------------------------------------|------------------------|
| 12  | IDL - E <sub>2</sub> | No voltage | Throttle valve open                                      | 8 - 14 V               |
|     | Vcc - E <sub>2</sub> |            | —                                                        | 4 - 6 V                |
|     | VTA - E <sub>2</sub> |            | Throttle valve fully closed<br>Throttle valve fully open | 0.1 - 1.0 V<br>3 - 5 V |

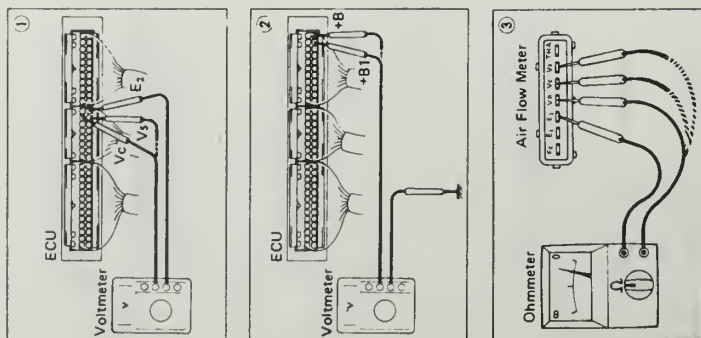
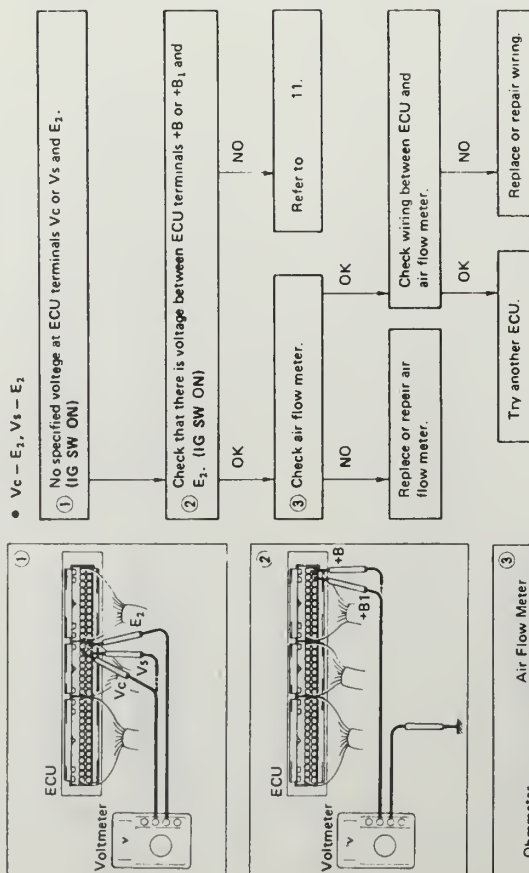
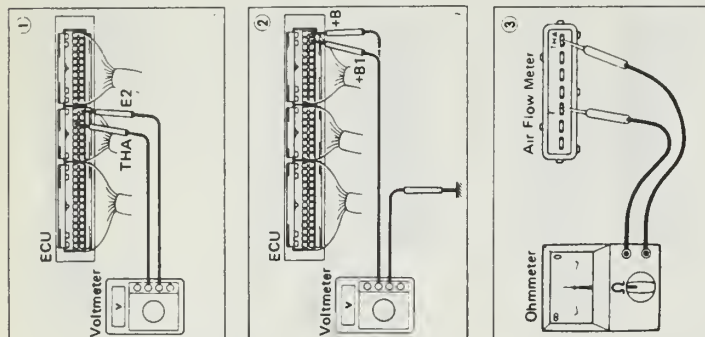
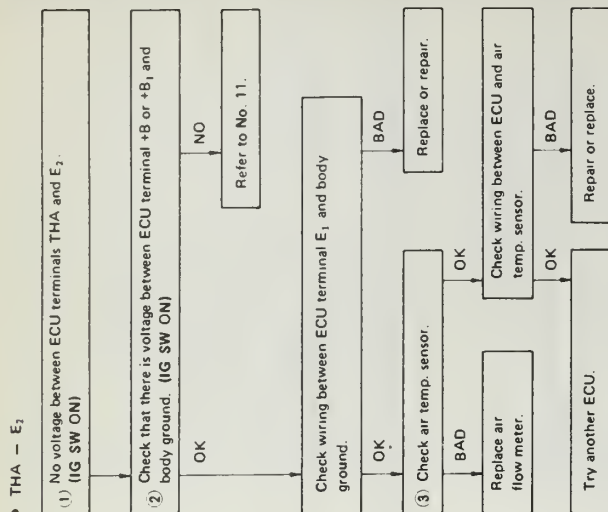
Throttle Position Sensor





# 5 FUEL SYSTEM

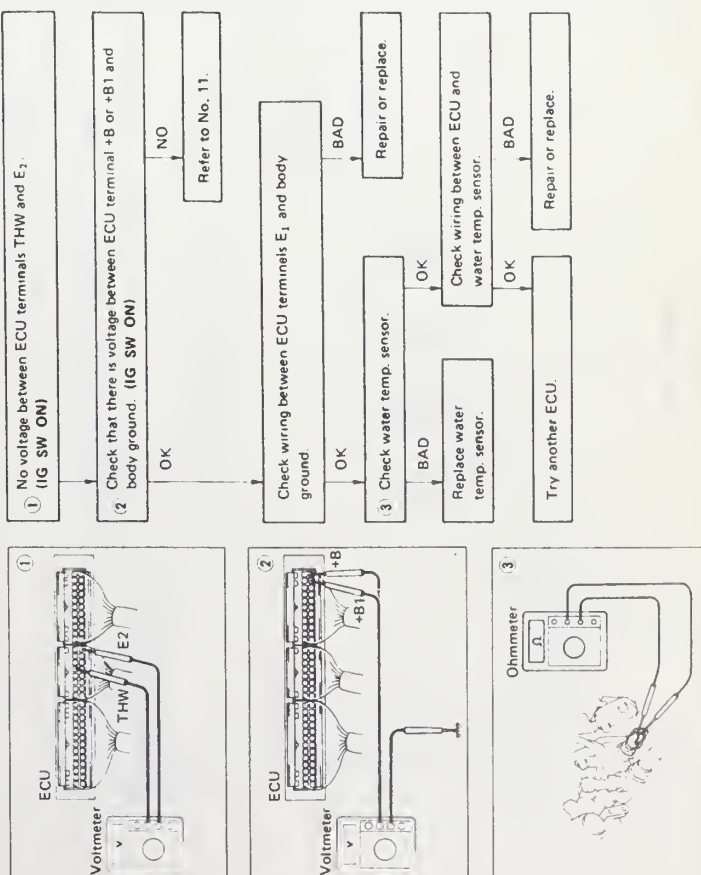
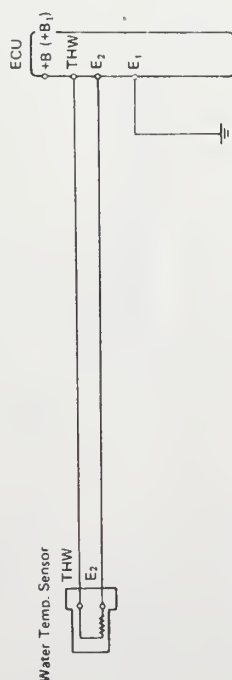
| No. | Terminals            | Trouble    | Condition                          | STD Voltage |
|-----|----------------------|------------|------------------------------------|-------------|
| 13  | Vc - E <sub>2</sub>  | No voltage | Ignition switch ON                 | 6 - 10 V    |
|     | Vs - E <sub>2</sub>  |            | Measuring plate fully closed       | 3.7 - 4.3 V |
|     | THA - E <sub>2</sub> |            | Measuring plate fully open         | 0.2 - 0.5 V |
|     | THA - E <sub>2</sub> |            | Idling                             | 2.3 - 2.8 V |
|     |                      |            | Intake air temperature 20°C (68°F) | 1 - 3 V     |

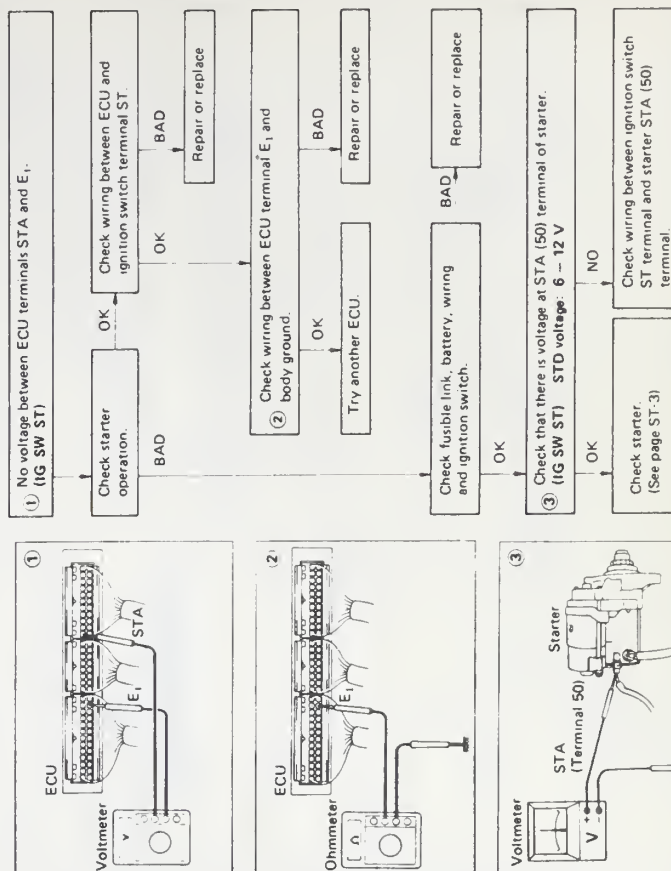
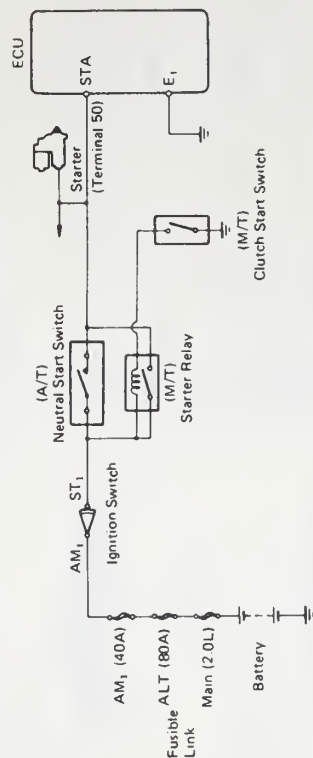
# ECU TEST NO. 14: 1989-90 VEHICLES WITH 22R-E 4WD W/AUTO. TRANS

# ECU TEST NO. 15: 1989-90 VEHICLES WITH 22R-E 4WD W/AUTO. TRANS

| No. | Terminals            | Trouble    | Condition                                              | STD Voltage |
|-----|----------------------|------------|--------------------------------------------------------|-------------|
| 14  | THW - E <sub>2</sub> | No voltage | Ignition switch ON<br>Coolant temperature 80°C (176°F) | 0.1 - 1.0 V |

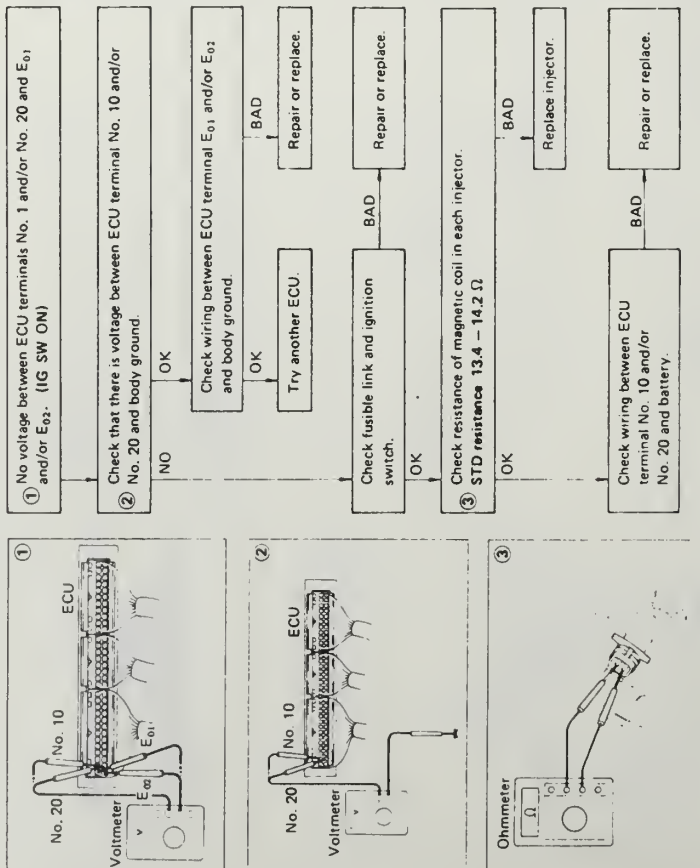
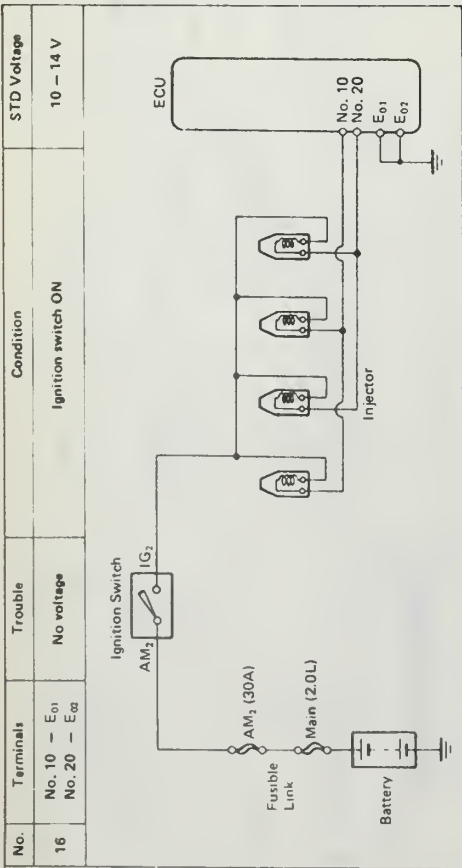


| No. | Terminals            | Trouble    | Condition                   | STD Voltage |
|-----|----------------------|------------|-----------------------------|-------------|
| 15  | STA - E <sub>1</sub> | No voltage | Ignition switch ST position | 6 - 12 V    |

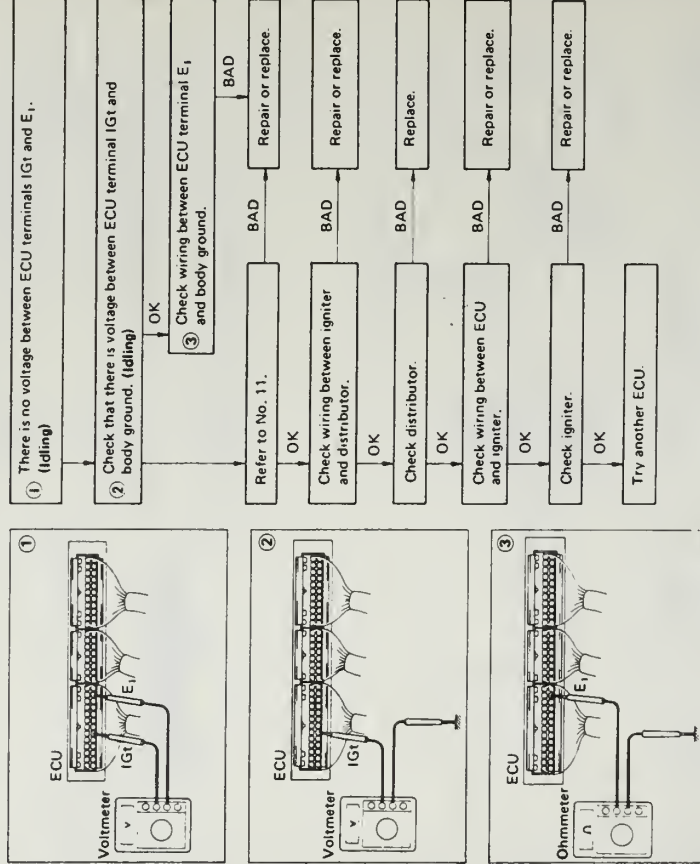
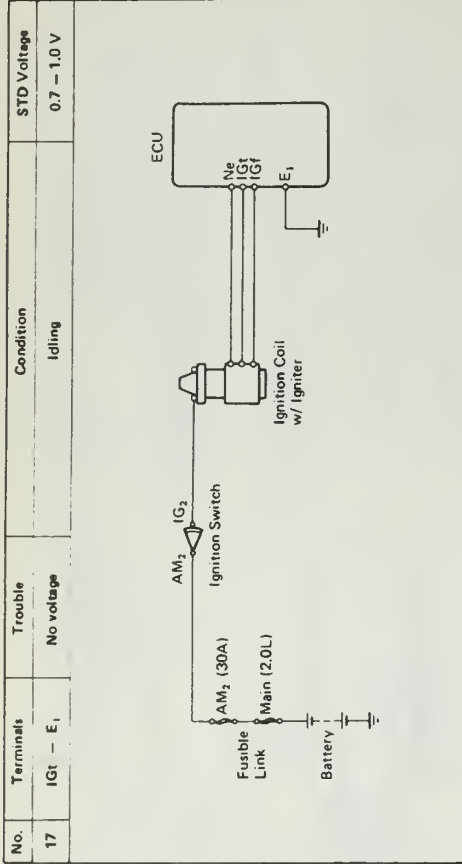




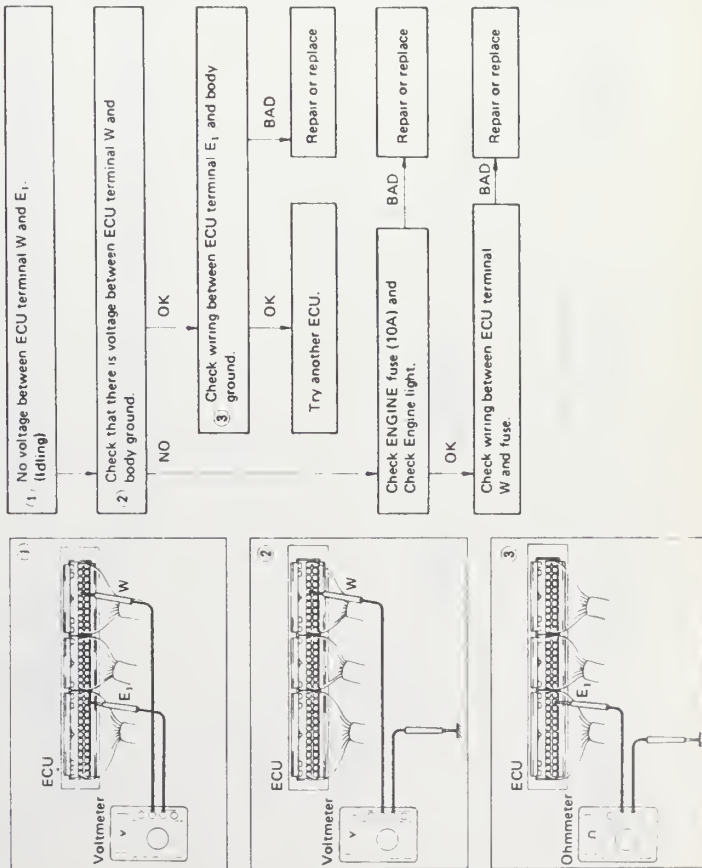
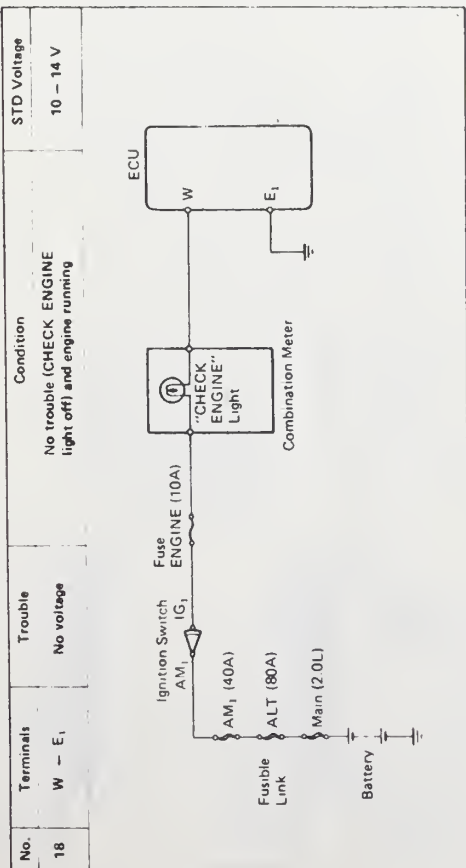
# ECU TEST NO. 16: 1989-90 VEHICLES WITH 22R-E 4WD W/AUTO. TRANS



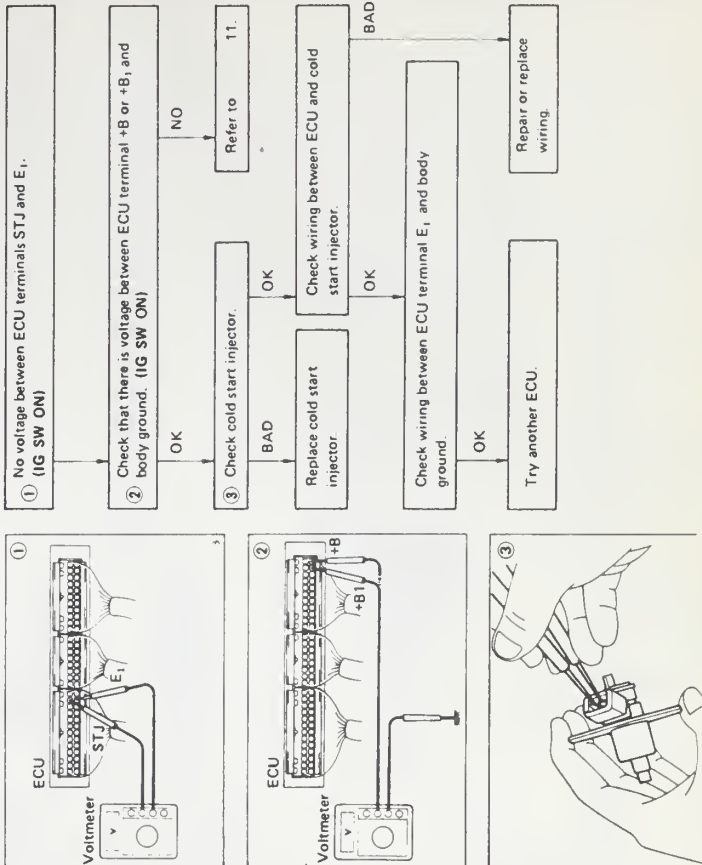
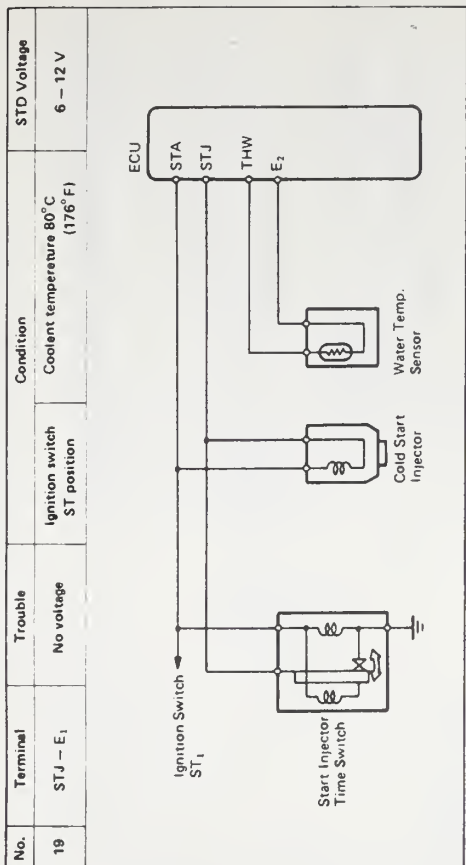
# ECU TEST NO. 17: 1989-90 VEHICLES WITH 22R-E 4WD W/AUTO. TRANS



# ECU TEST NO. 18: 1989-90 VEHICLES WITH 22R-E 4WD W/AUTO. TRANS



# ECU TEST NO. 19: 1989-90 VEHICLES WITH 22R-E 4WD W/AUTO. TRANS





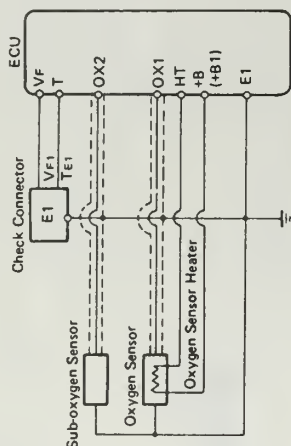
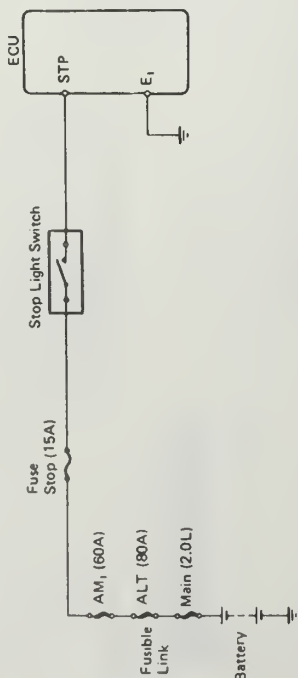
**22R-E 4WD W/AUTO. TRANS**

**22R-E, 4WD W/AUTO. TRANS.**

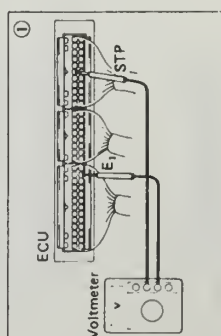
| No. | Terminals            | Trouble    | Condition            | STD Voltage |
|-----|----------------------|------------|----------------------|-------------|
| 20  | STP - E <sub>1</sub> | No voltage | Stop light switch ON | 8 - 14 V    |

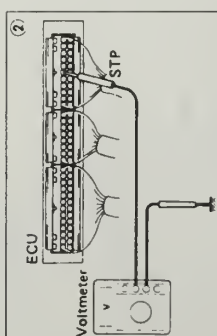
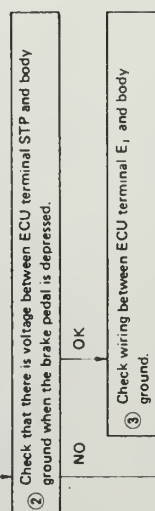
The diagram illustrates the wiring for the stop light switch. The battery is connected to a fusible link, which leads to a main fuse (2.0L). This is followed by a fuse stop (15A) and a stop light switch. The switch is connected to the STP terminal of the ECU. The ECU's E1 terminal is grounded. The diagram also shows the locations of fuses: AM1 (60A), ALT (80A), and Main (2.0L).



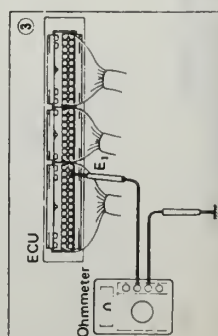
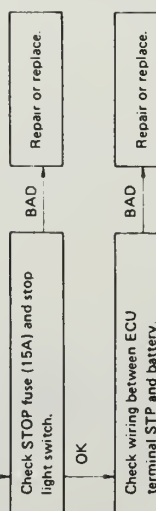
(California Vehicles only)



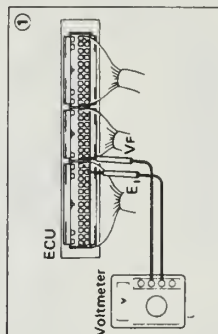
① No voltage between ECU terminals STP and E<sub>1</sub>.



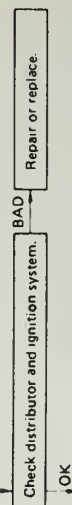
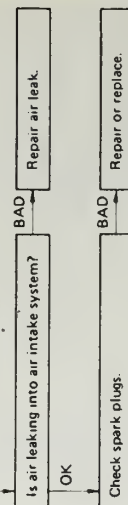
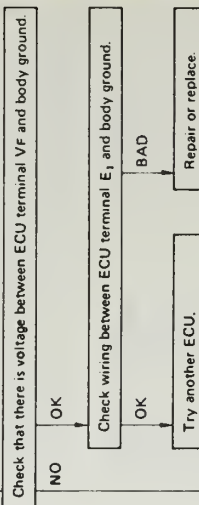
|    |     |
|----|-----|
| OK | BAD |
|----|-----|



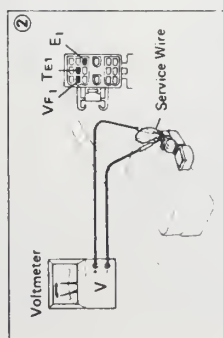
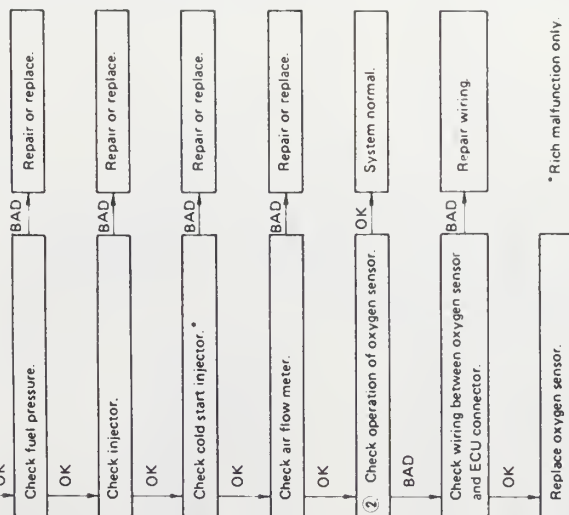
|                          |     |
|--------------------------|-----|
| Check wiring between ECU | BAD |
|--------------------------|-----|



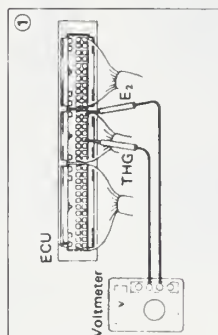
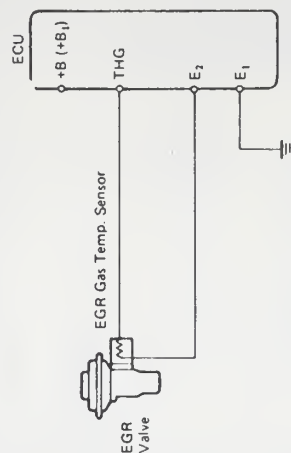
① There is no voltage between ECU terminals VF and E<sub>1</sub>.



CONTINUED



(California vehicles only)



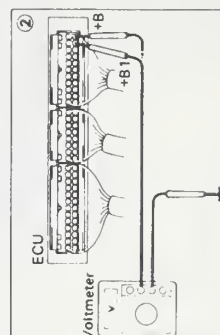
① No voltage between ECU terminals THG and E<sub>2</sub>.  
(Engine running at 2,000 rpm)

② Check that there is voltage between ECU terminal +B or +B<sub>1</sub> and body ground. (IG SW ON)

OK

NO

Refer to No. 11.



Check wiring between ECU terminal E<sub>1</sub> and body ground.

OK

BAD

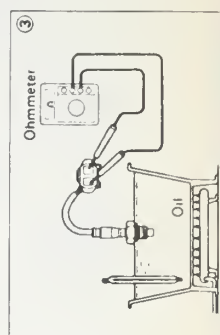
Repair or replace.

Check EGR system.

OK

BAD

Repair or replace.



Check EGR gas temp. sensor.

OK

BAD

Replace EGR gas temp. sensor.

Check wiring between ECU and EGR gas temp. sensor.

OK

BAD

Repair or replace.

Try another ECU.

# 5 FUEL SYSTEM

## FAULT CODES — 1991 TRUCKS WITH 22R-E

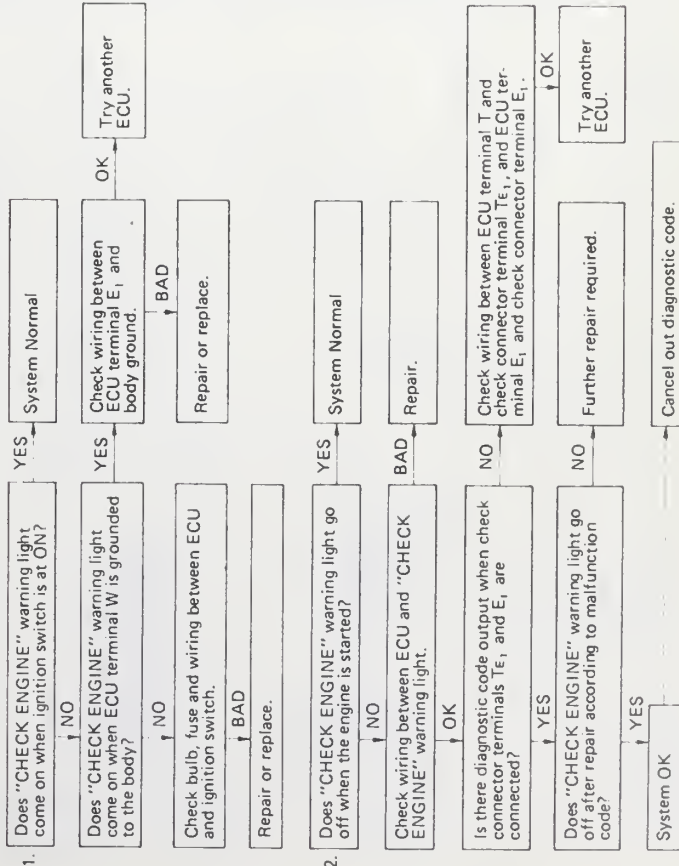
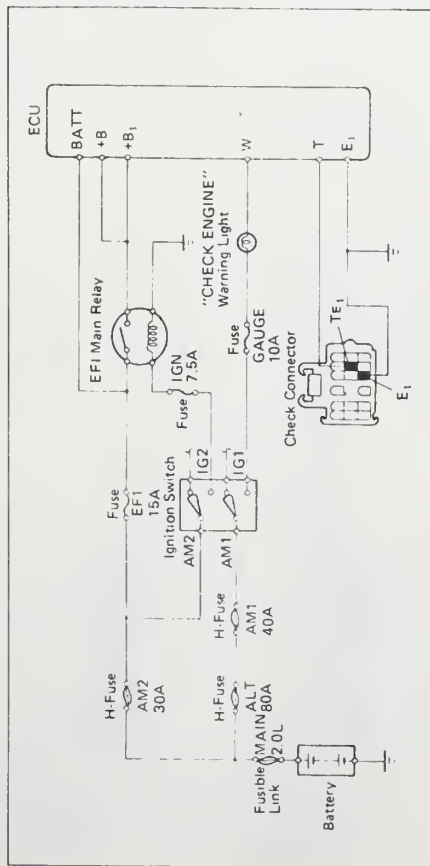
| Code No. | Number of blinks "CHECK ENGINE" Warning Light | System                             | Diagnosis                                                                                                                                                                                                                                                                                                                                                                                     | Trouble Area                                                                                                                                                                                                                                                                                                                             | *2 Memory |
|----------|-----------------------------------------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| —        | —                                             | Normal                             | Output when no other code is recorded.                                                                                                                                                                                                                                                                                                                                                        | —                                                                                                                                                                                                                                                                                                                                        | —         |
| 12       | — 00000000                                    | RPM Signal                         | No NE signal is input to the ECU for 2 secs. or more after STA turns ON                                                                                                                                                                                                                                                                                                                       | • Open or short in NE circuit<br>• Distributor<br>• Open or short in STA circuit<br>• ECU                                                                                                                                                                                                                                                | ○         |
| 13       | — 00000000                                    | RPM Signal                         | NE signal is not input to ECU for 300 msec. or more when engine speed is 1,500 rpm or more                                                                                                                                                                                                                                                                                                    | • Open or short in NE circuit<br>• Distributor<br>• ECU                                                                                                                                                                                                                                                                                  | ○         |
| 14       | — 00000000                                    | Ignition Signal                    | IGF signal from igniter is not input to ECU for 4 consecutive ignition                                                                                                                                                                                                                                                                                                                        | • Open or short in IGF or IGT circuit<br>• Igniter<br>• ECU                                                                                                                                                                                                                                                                              | ○         |
| 21       | — 00000000                                    | Main Oxygen Sensor Signal          | (1) Open or short in heater circuit of main oxygen sensor for 500 msec. or more (HT)<br>(2) At normal driving speed (below 60 mph and engine speed is above 1,700 rpm), amplitude of main oxygen sensor signal continuously for 60 secs. or more<br>• 6 (2 trip detection logic) (2)                                                                                                          | • Open or short in heater circuit of main oxygen sensor<br>• Main oxygen sensor heater<br>• ECU<br>• Open or short in main oxygen sensor circuit<br>• Main oxygen sensor<br>• ECU                                                                                                                                                        | ○         |
| 22       | — 00000000                                    | Water Temp Sensor Signal           | Open or short in water temp. sensor circuit for 500 msec. or more (THW)                                                                                                                                                                                                                                                                                                                       | • Open or short in water temp. sensor circuit<br>• Water temp. sensor<br>• ECU                                                                                                                                                                                                                                                           | ○         |
| 24       | — 00000000                                    | Intake Air Temp Sensor Signal      | Open or short in intake air temp. sensor circuit for 500 msec. or more (THA)                                                                                                                                                                                                                                                                                                                  | • Open or short in intake air temp. sensor circuit<br>• Intake air temp. sensor<br>• ECU                                                                                                                                                                                                                                                 | ○         |
| 25       | — 00000000                                    | Air-Fuel Ratio Sensor Mal function | (1) Oxygen sensor output is less than 0.45 V for at least 90 secs. when oxygen sensor is warmed up (racing at 2,000 rpm). — Only for code 25.<br>(2) When air-fuel ratio feedback correction value is not within the feedback correction limit for a certain period of time or adaptive control value is not renewed for a certain period of time<br>• 6 (2 trip detection logic) (1) and (2) | • Engine ground bolt loose<br>• Open in E1 circuit<br>• Open in injector circuit<br>• Fuel pressure injector blockage<br>• Open or short in oxygen sensor circuit<br>• Oxygen sensor<br>• Ignition system<br>• Air-fuel ratio sensor<br>• Air flow meter (Air intake)<br>• ECU                                                           | ○         |
| 26       | — 00000000                                    | Air-Fuel Ratio Sensor Mal function | • 6 (2 trip detection logic) (1) and (2)                                                                                                                                                                                                                                                                                                                                                      | • Engine ground bolt loose<br>• Open in E1 circuit<br>• Open in injector circuit<br>• Fuel pressure injector blockage<br>• Open or short in oxygen sensor circuit<br>• Cold start injector<br>• Open or short in oxygen sensor circuit<br>• Oxygen sensor<br>• Water temp. sensor<br>• Air flow meter<br>• Compression pressure<br>• ECU | ○         |

| Code No. | Number of blinks "CHECK ENGINE" Warning Light | System                          | Diagnosis                                                                                                                                                                                                                                                                                                    | Trouble Area                                                                                                                                          | *2 Memory |
|----------|-----------------------------------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| *5 27    | — 00000000                                    | Sub-Oxygen Sensor Signal        | (1) When sub-oxygen sensor is warmed up and full acceleration continued for 2 seconds, output of main oxygen sensor is 0.45 V or more rich and output of sub-oxygen sensor is 0.45 V or more lean only for 500 msec. or more in sub-oxygen sensor heater circuit<br>• 6 (2 trip detection logic) (1) and (2) | • Short or open in sub-oxygen sensor circuit<br>• Sub-oxygen sensor<br>• Open or short in sub-oxygen sensor heater<br>• ECU                           | ○         |
| 31       | — 00000000                                    | Air Flow Meter Signal           | Open or short detected continuously for 100 msec. or more in air flow meter circuit<br>• Open — VC or E2<br>• Short — VC or VS — VC                                                                                                                                                                          | • Open or short in air flow meter circuit<br>• Air flow meter<br>• ECU                                                                                | ○         |
| 41       | — 00000000                                    | Throttle Position Sensor Signal | Open or short detected in throttle position sensor signal (VTA) for 500 msec. or more                                                                                                                                                                                                                        | • Open or short in throttle position sensor circuit<br>• Throttle position sensor<br>• ECU                                                            | ○         |
| 42       | — 00000000                                    | Vehicle Speed Sensor Signal     | SPO signal is not input to the ECU for at least 8 seconds during high load driving with engine speed between 2,200 rpm and 5,000 rpm.                                                                                                                                                                        | • Open or short in vehicle speed sensor circuit<br>• Vehicle speed sensor<br>• ECU                                                                    | ○         |
| 43       | — 00000000                                    | Starter Signal                  | Starter signal (STA) is not input to ECU even once until engine reaches 800 rpm or more when cranking                                                                                                                                                                                                        | • Open or short in starter signal circuit<br>• Starter relay<br>• Open or short in IG SW or main relay circuit<br>• ECU                               | ○         |
| 52       | — 00000000                                    | Knock Sensor Signal             | With engine speed 2,000 rpm or more signal input to ECU is not input to ECU for 25 revolution (KNK)                                                                                                                                                                                                          | • Open or short in knock sensor circuit<br>• Knock sensor (looseness, etc.)<br>• ECU                                                                  | ○         |
| 53       | — 00000000                                    | Knock Control Signal            | The engine control computer (for knock control) malfunction is detected                                                                                                                                                                                                                                      | • ECU                                                                                                                                                 | ○         |
| *5 71    | — 00000000                                    | EGR System Mal function         | EGR gas temp. sensor signal (THG) is below 60°C (140°F) after driving for 50 seconds in EGR operation range<br>• 6 (2 trip detection logic)                                                                                                                                                                  | • Open in EGR gas temp. sensor circuit<br>• Open in VSV circuit for EGR<br>• EGR vacuum hose disconnection<br>• Collapsed in EGR gas passage<br>• ECU | ○         |
| 51       | — 00000000                                    | Switch Condition Signal         | Displayed when IDL contact OFF or shift lever in P position, or when engine is cranked with the check terminals E1 and TE1 connected.                                                                                                                                                                        | • Throttle position sensor IDL circuit<br>• Neutral start switch circuit<br>• Accelerator pedal, cable<br>• ECU                                       | ○         |

### REMARKS

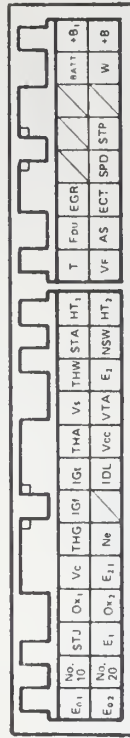
- \*1: "ON" displayed in the diagnosis mode column indicates that the "CHECK ENGINE" Warning Light is lighted up when a malfunction is detected.
- \*2: "OFF" indicates that the "CHECK" does not light up during malfunction diagnosis, even if a malfunction is detected.
- \*3: "○" in the memory column indicates that a diagnostic code is recorded in the ECU memory when a malfunction occurs. "x" indicates that a diagnostic code is not recorded in the ECU memory even if a malfunction occurs. Accordingly, output of diagnostic results is performed with the IG SW ON.
- \*4: The "CHECK ENGINE" Warning Light comes on if malfunction occurs only for California specifications.
- \*5: No. (2) in the diagnostic contents of codes No. 25 and 26 apply to California specification vehicles only, while (1) applies to all models.
- \*6: Codes 27 and 71 are used only for California specifications.
- \*7: "2" trip detection logic"

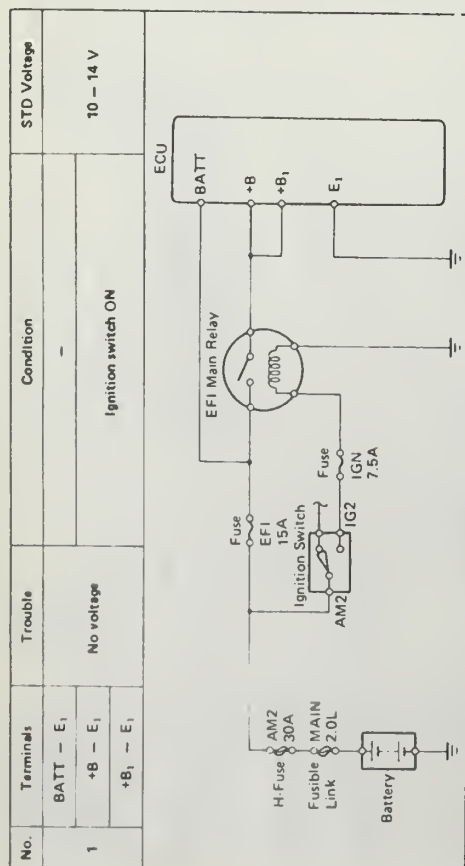




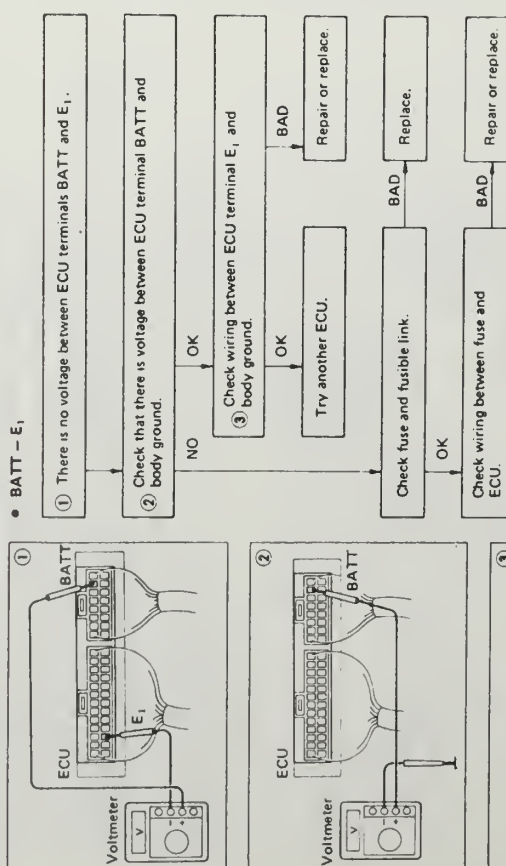
| Symbol | Terminal Name            | Symbol | Terminal Name               |
|--------|--------------------------|--------|-----------------------------|
| E01    | ENGINE GROUND            | THW    | WATER TEMP. SENSOR          |
| E02    | ENGINE GROUND            | E2     | SENSOR GROUND               |
| No. 10 | INJECTOR                 | STA    | STARTER SWITCH              |
| No. 20 | INJECTOR                 | *2 NSW | NEUTRAL START SWITCH        |
| STJ    | COLD START INJECTOR      | HT1    | OXYGEN SENSOR HEATER (MAIN) |
| E1     | ENGINE GROUND            | *1 HT2 | OXYGEN SENSOR HEATER (SUB)  |
| Ox1    | OXYGEN SENSOR (MAIN)     | T      | CHECK CONNECTOR             |
| *1 Ox2 | OXYGEN SENSOR (SUB)      | Vf     | CHECK CONNECTOR             |
| VC     | AIR FLOW METER           | Fpu    | FUEL PRESSURE CONTROL VSV   |
| E21    | SENSOR GROUND            | AS     | AS VSV                      |
| *1 THG | EGR GAS TEMP. SENSOR     | EGR    | EGR VSV                     |
| Ne     | DISTRIBUTOR              | *2 ECT | OD RELAY                    |
| IGf    | IGNITER                  | SPD    | SPEED SENSOR                |
| IGt    | IGNITER                  | STP    | STOP LIGHT SWITCH           |
| IDL    | THROTTLE POSITION SENSOR | BATT   | BATTERY +B                  |
| THA    | AIR TEMP. SENSOR         | W      | CHECK ENGINE WARNING LIGHT  |
| Vcc    | THROTTLE POSITION SENSOR | +B1    | MAIN RELAY                  |
| Vs     | AIR FLOW METER           | +B     | MAIN RELAY                  |
| VTA    | THROTTLE POSITION SENSOR |        |                             |

\*1: California only \*2: A/T only

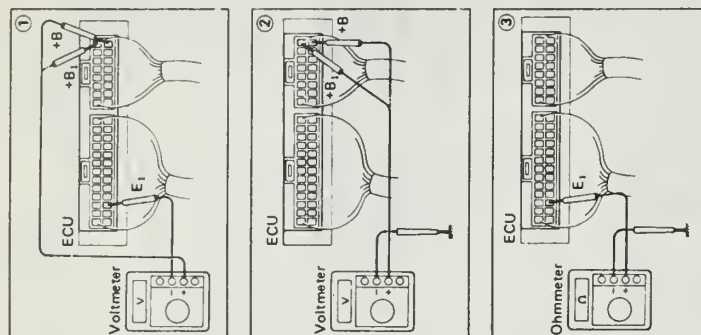
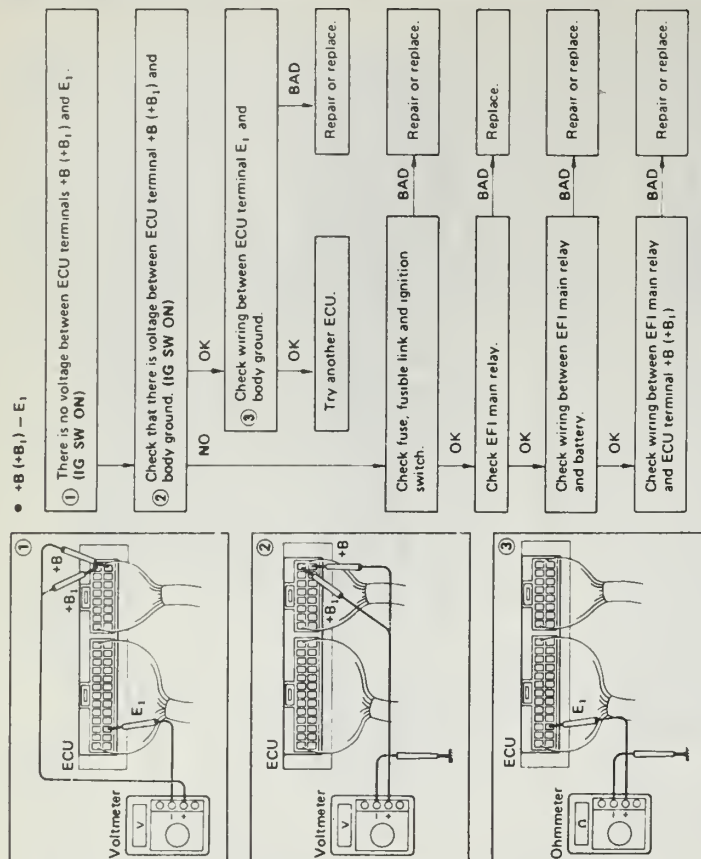




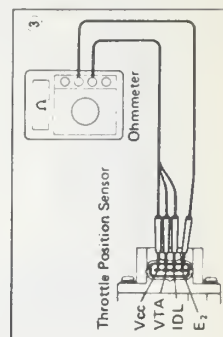
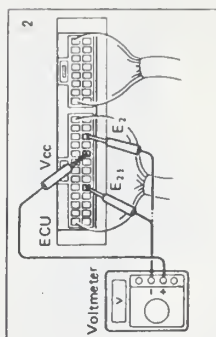
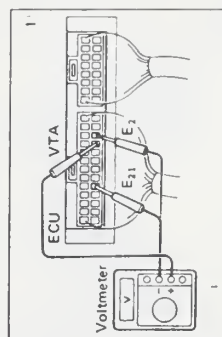
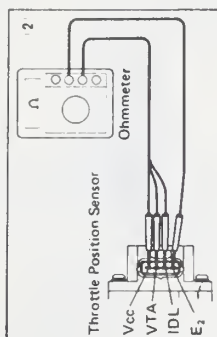
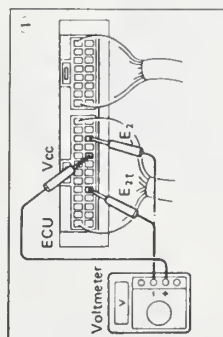
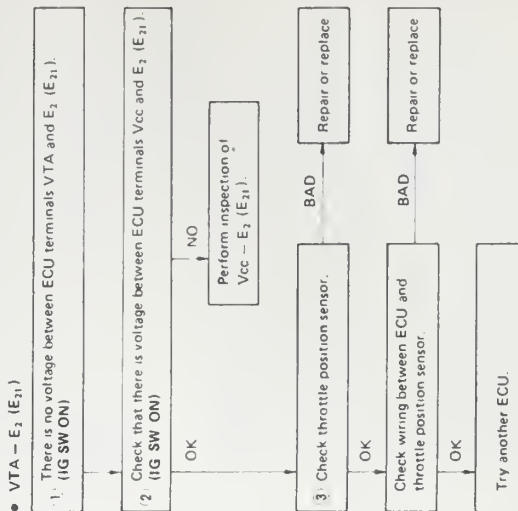
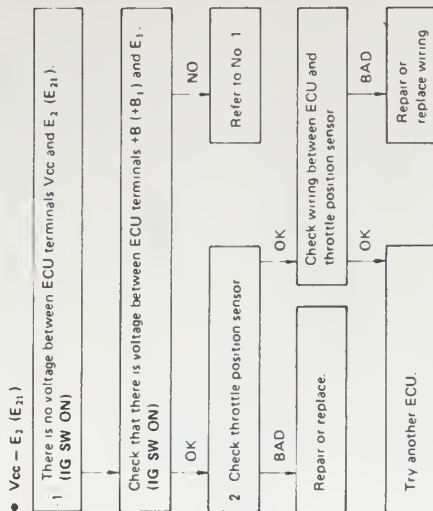
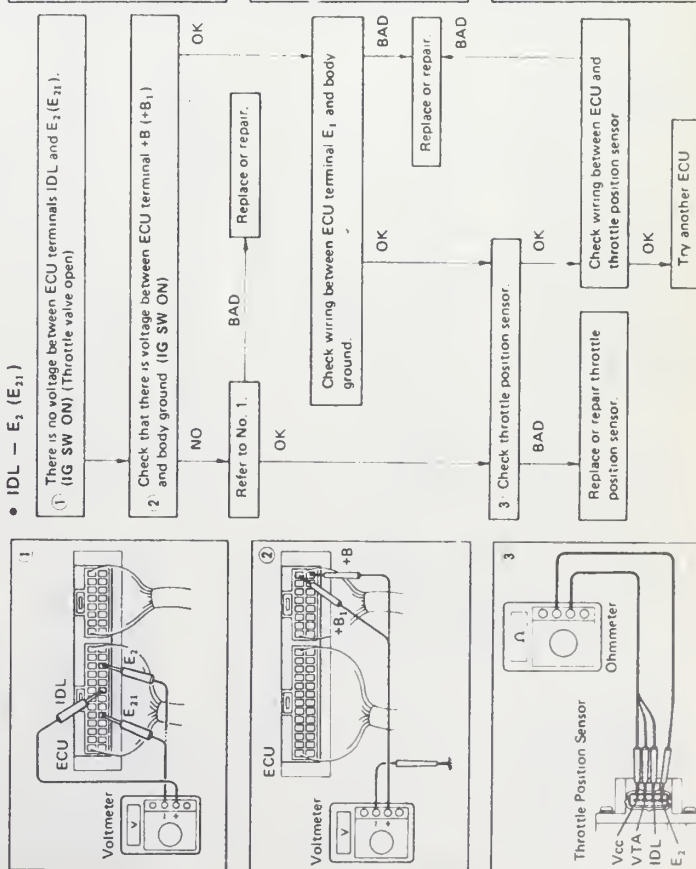
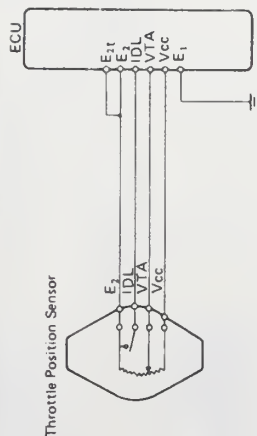
• BATT — E<sub>1</sub>



• +B (+B<sub>1</sub>) — E<sub>1</sub>



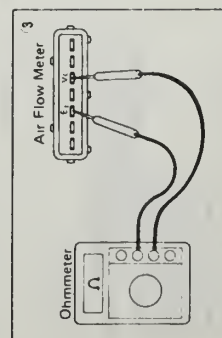
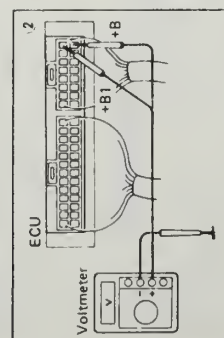
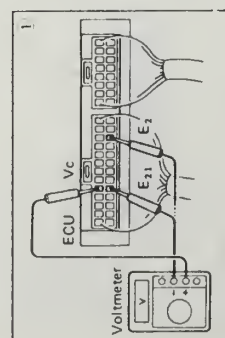
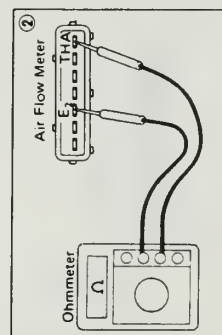
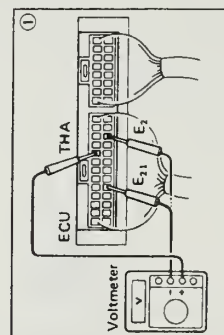
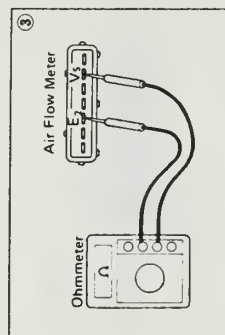
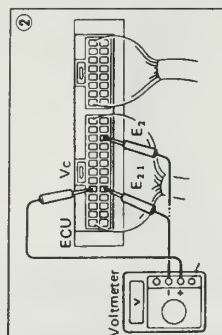
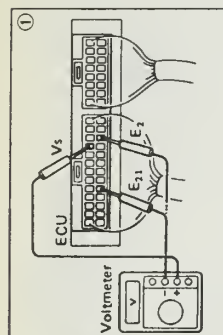
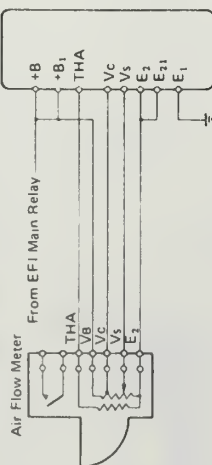
| No. | Terminals                               | Trouble    | Condition                                                | STD Voltage            |
|-----|-----------------------------------------|------------|----------------------------------------------------------|------------------------|
| 2   | IDL — E <sub>2</sub> (E <sub>31</sub> ) | No voltage | Throttle valve open                                      | 8 — 14 V               |
|     | Vcc — E <sub>2</sub> (E <sub>31</sub> ) |            | —                                                        | 4 — 6 V                |
|     | VTA — E <sub>2</sub> (E <sub>31</sub> ) |            | Throttle valve fully closed<br>Throttle valve fully open | 0.1 — 1.0 V<br>3 — 5 V |





## 5 FUEL SYSTEM

| No | Terminals            | Trouble    | Condition                          | STD Voltage |
|----|----------------------|------------|------------------------------------|-------------|
| 3  | $V_C - E_1 (E_{11})$ | No voltage | —                                  | 6–10 V      |
|    |                      |            | Measuring plate fully closed       | 0.5–2.5 V   |
|    | $V_S - E_1 (E_{21})$ |            | Measuring plate fully open         | 5–10 V      |
|    |                      |            | Idling                             | 2–8 V       |
|    | $THA - E_1 (E_{21})$ |            | Intake air temperature 20°C (68°F) | 1–3 V       |

 $\bullet V_3 - E_2 (E_{21})$ 

① There is no voltage between ECU terminals Vs and E<sub>2</sub> (E<sub>21</sub>).

Check that there is voltage between ECU terminals Vc and E<sub>2</sub> (E<sub>31</sub>).

```

 Refer to $V_C - E_s$ (E_s)
 BAD → Repair or replace

```

③ Check air flow meter.

|                                             |     |                    |
|---------------------------------------------|-----|--------------------|
| Check wiring between ECU and air flow meter | BAD | Repair or replace. |
|---------------------------------------------|-----|--------------------|

Try another ECU.

- $\text{THA} - E_2 (E_2)$

① There is no voltage between ECU terminals THA and E<sub>2</sub> (E<sub>21</sub>).  
(IG SW ON)

Check that there is voltage between ECU terminal +B (+B<sub>1</sub>) and body ground (IG SW ON)

② Check air temp, sensor.

Replace air flow meter.

Try another ECU.

- $V_C - E_2 (E_{21})$

There is no voltage between ECU terminals Vc and E<sub>2</sub> (E<sub>21</sub>).

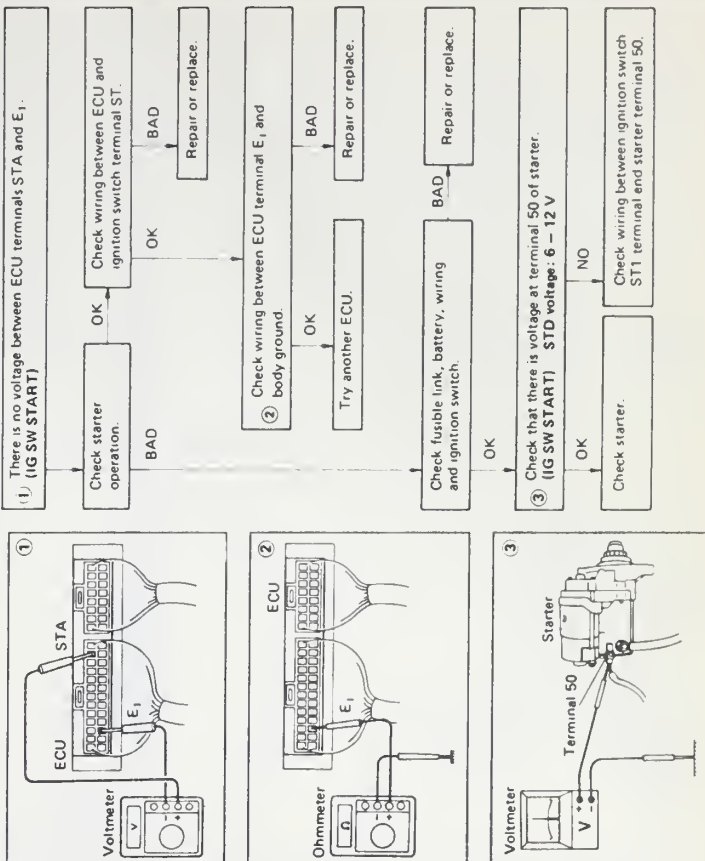
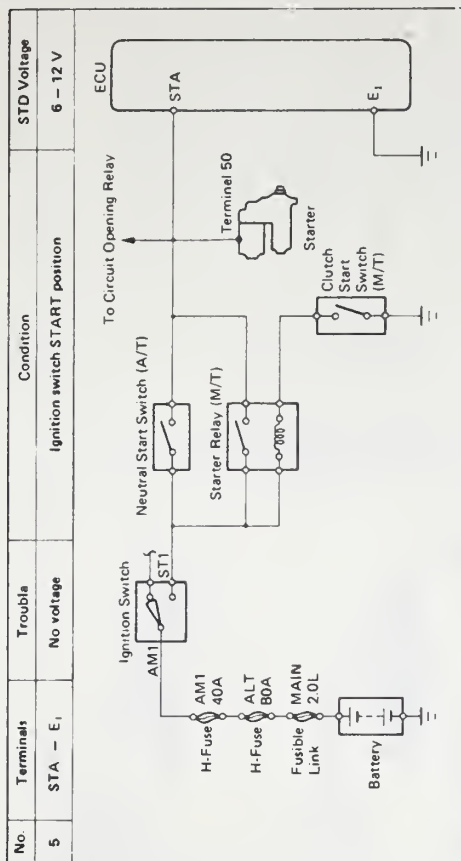
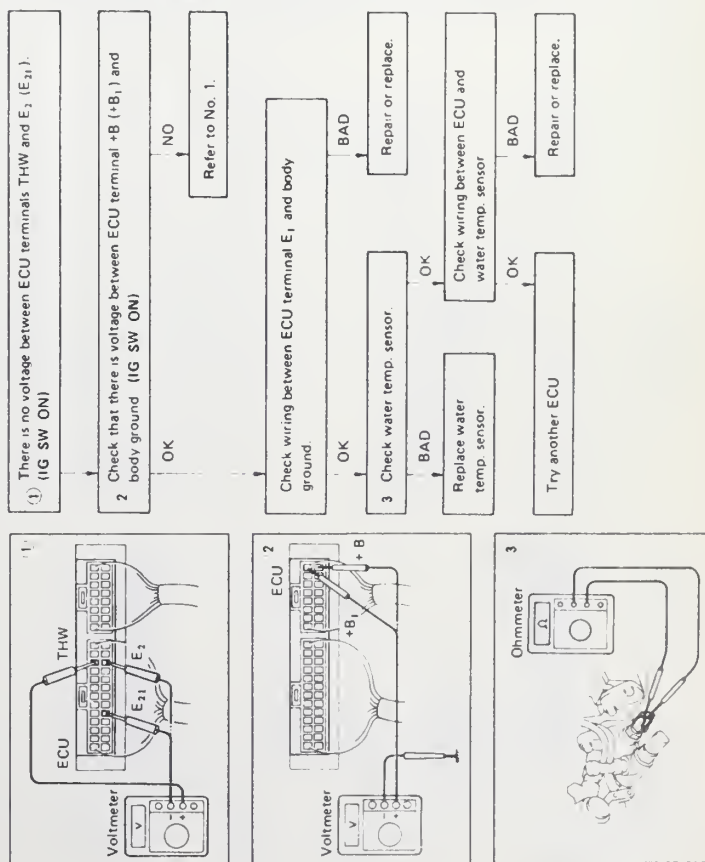
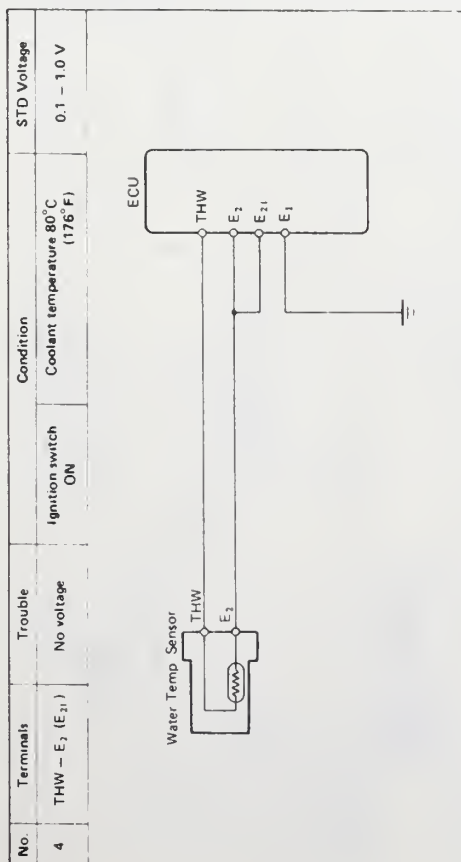
2 Check that there is voltage between ECU terminals +B (+B<sub>1</sub>) and E<sub>1</sub> (IG SW ON)

③ Check air flow meter.

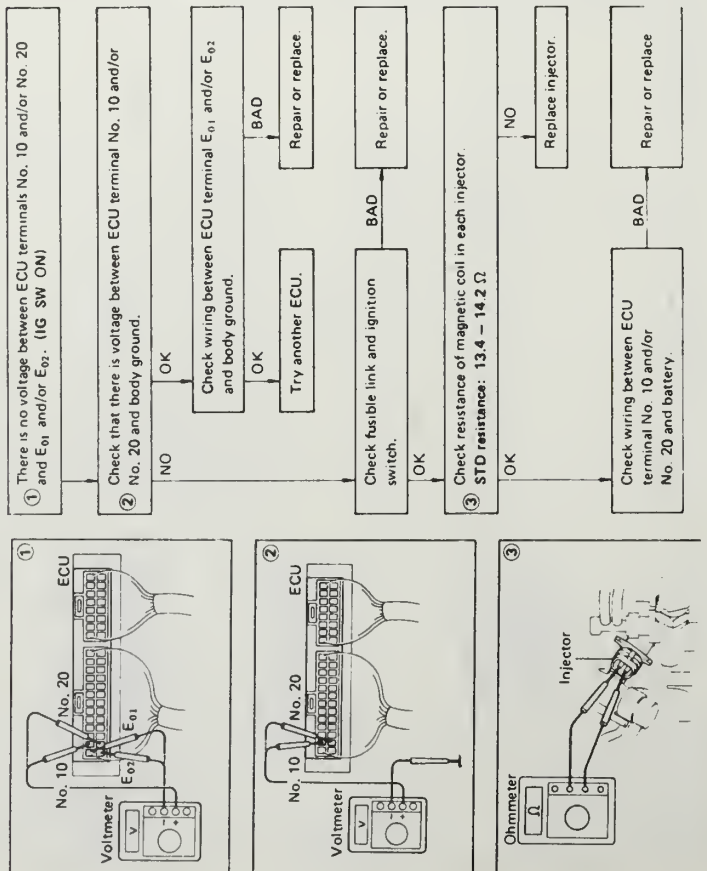
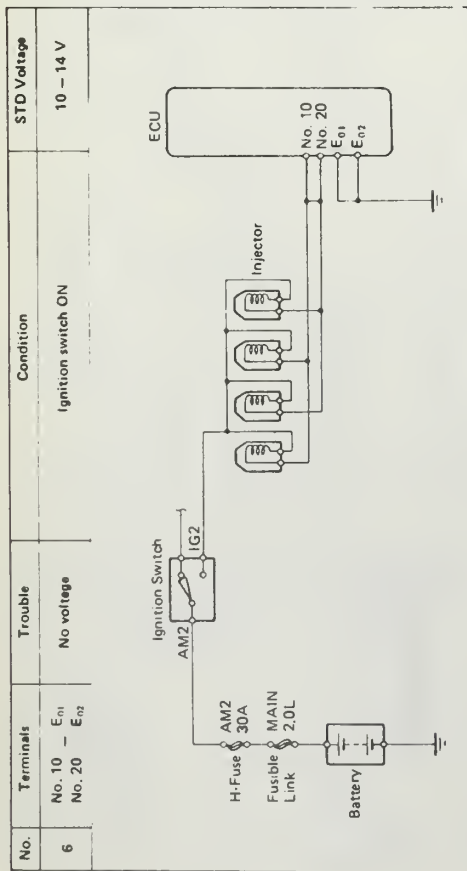
|                                   |                                      |
|-----------------------------------|--------------------------------------|
| Replace or repair air flow meter. | Check wiring between air flow meter. |
|-----------------------------------|--------------------------------------|

Try another ECU.

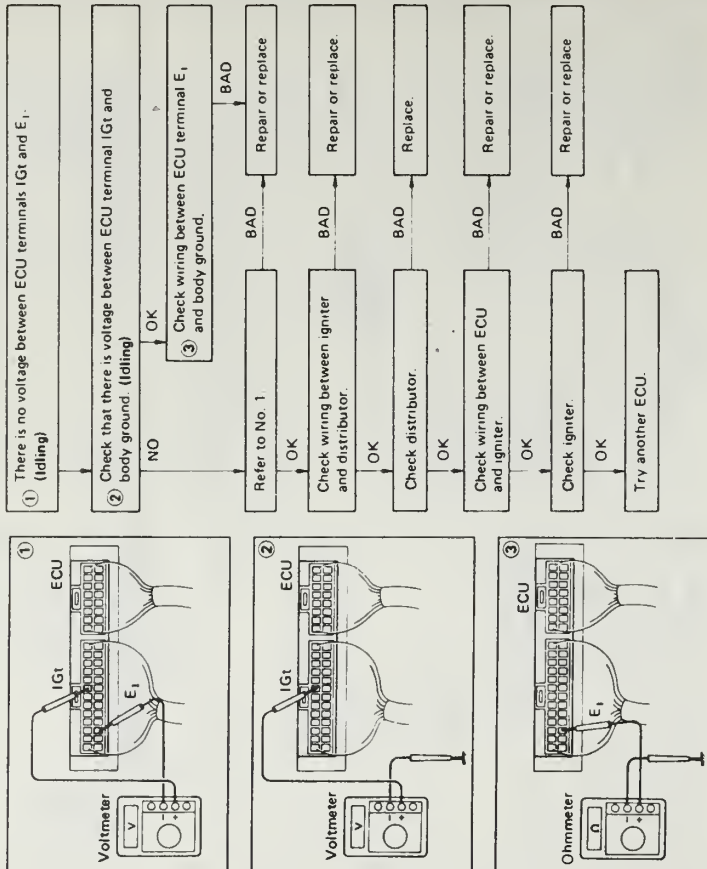
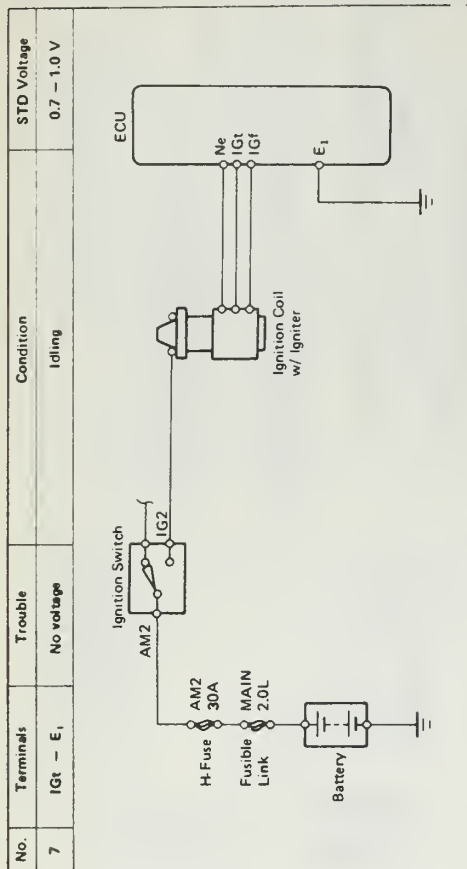
Replace or repair wiring.



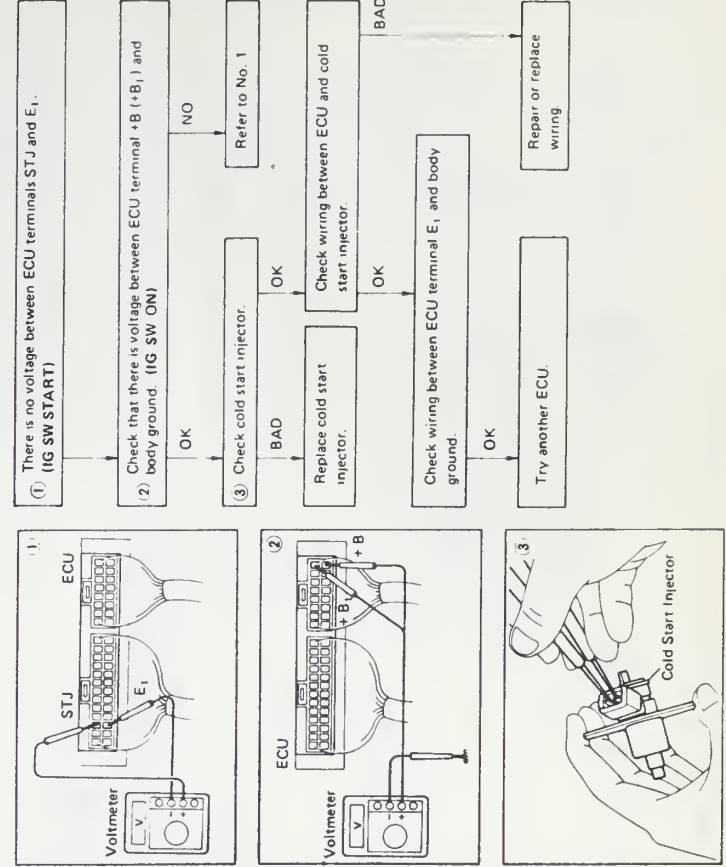
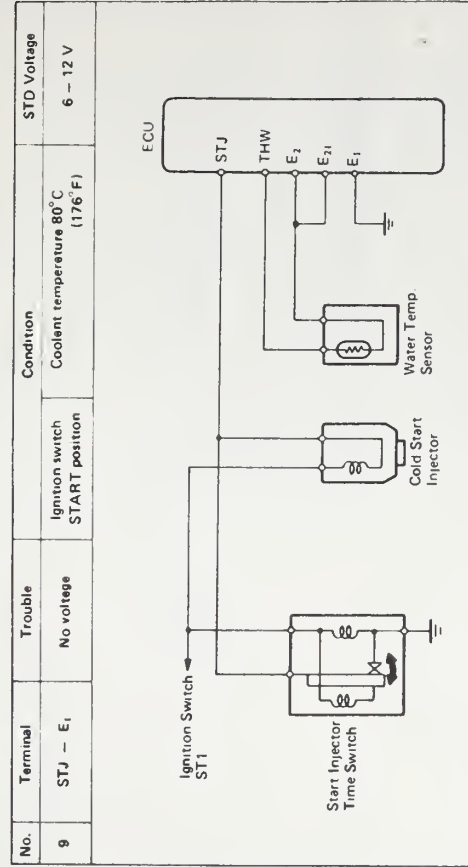
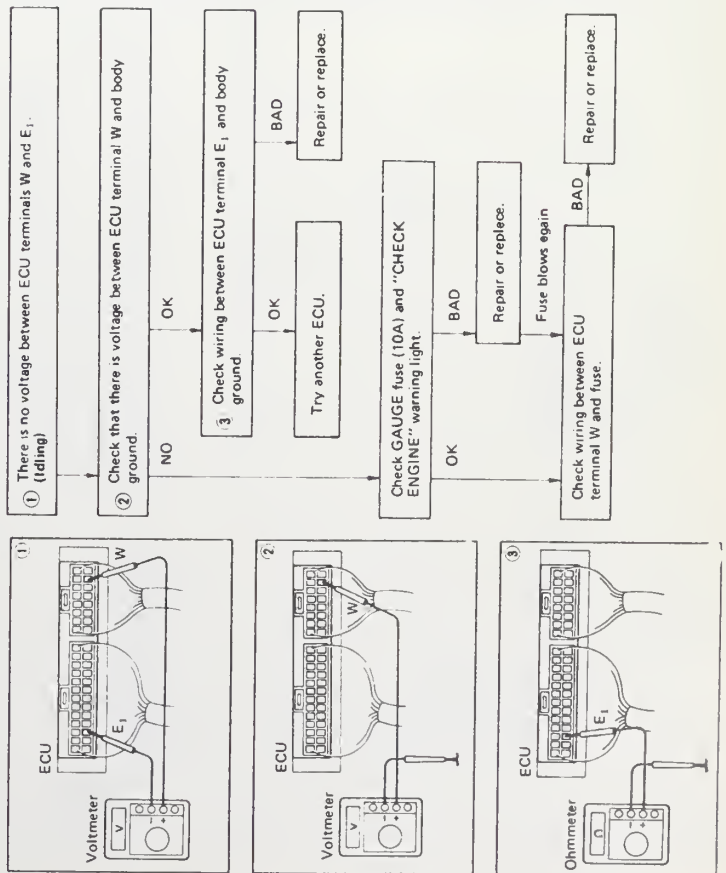
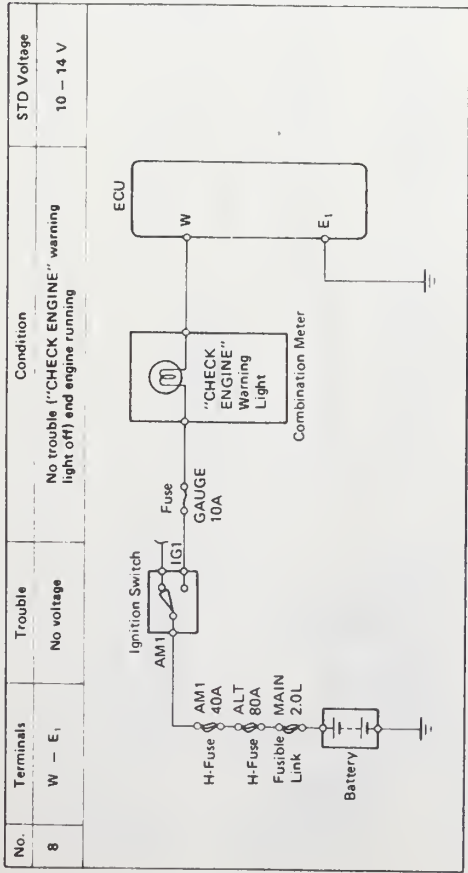
# ECU TEST NO. 6: — 1991 2WD TRUCKS WITH 22R-E



# ECU TEST NO. 7: — 1991 2WD TRUCKS WITH 22R-E

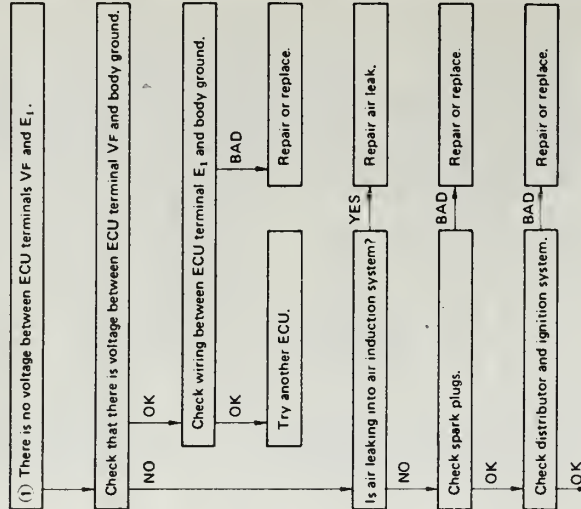
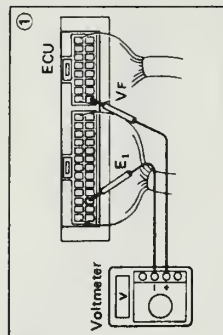
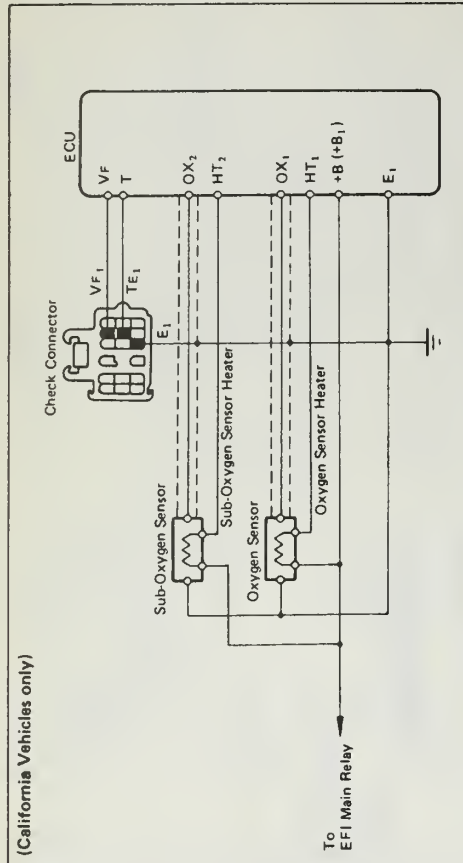
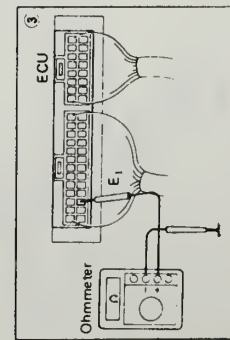
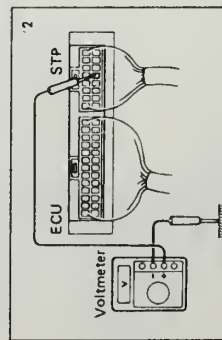
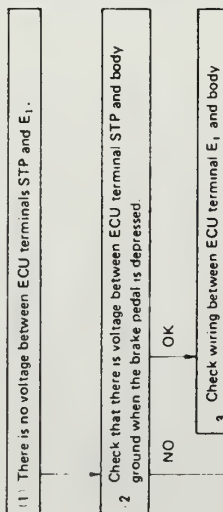
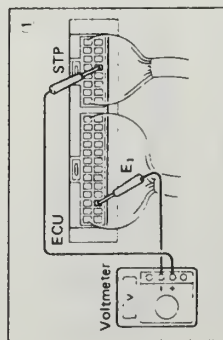
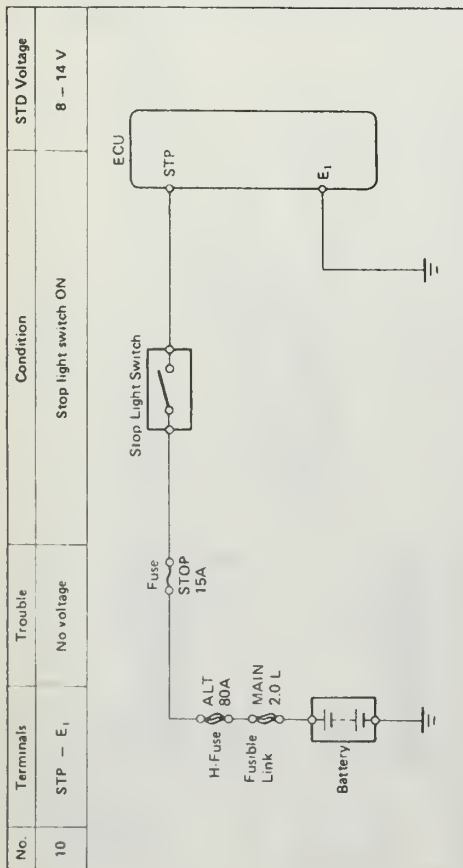




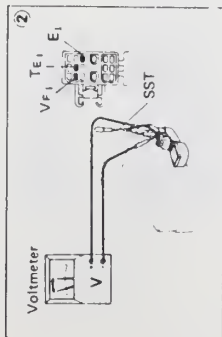
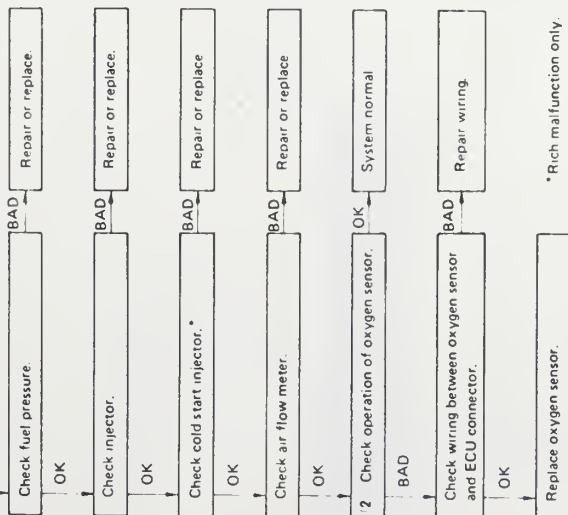


# ECU TEST NO. 10: — 1991 2WD TRUCKS WITH 22R-E

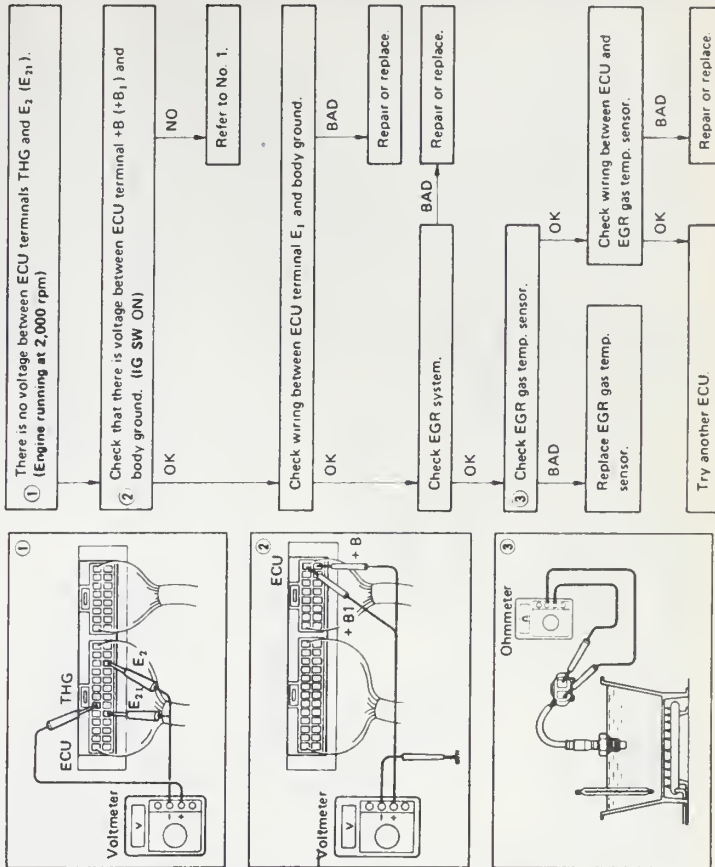
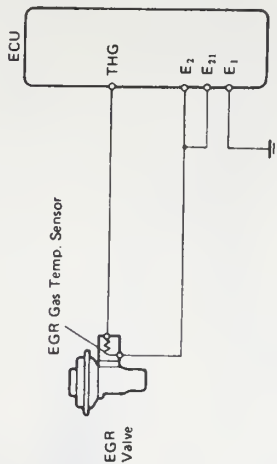
## SUB-OXYGEN SENSOR AND HEATER TEST — 1991 2WD TRUCKS WITH 22R-E



CONTINUED



(California Vehicles only)

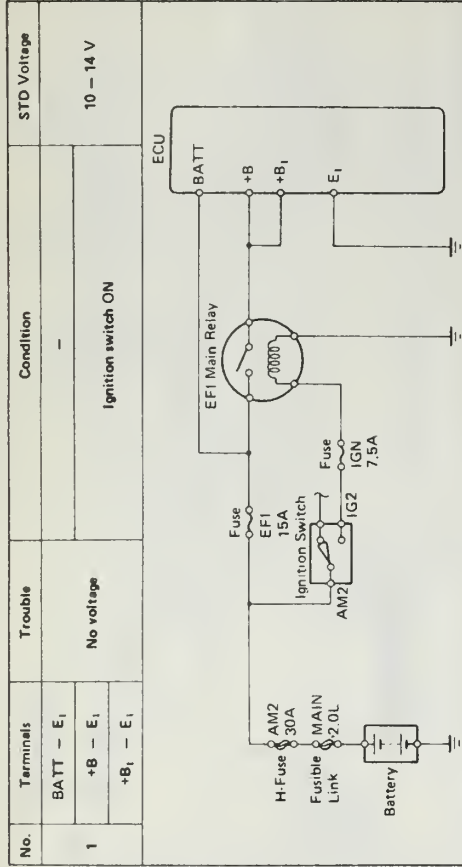




| Symbol          | Terminal Name               | Symbol            | Terminal Name              |
|-----------------|-----------------------------|-------------------|----------------------------|
| E01             | ENGINE GROUND               | * O <sub>x2</sub> | OXYGEN SENSOR (SUB)        |
| E02             | ENGINE GROUND               | O <sub>x1</sub>   | OXYGEN SENSOR (MAIN)       |
| No. 10          | INJECTOR                    | * THG             | EGR GAS TEMP. SENSOR       |
| No. 20          | INJECTOR                    | V <sub>cc</sub>   | THROTTLE POSITION SENSOR   |
| STA             | STARTER SWITCH              | KNK               | KNOCK SENSOR               |
| IGt             | IGNITER                     | VTA               | THROTTLE POSITION SENSOR   |
| STJ             | COLD START INJECTOR         | N <sub>e</sub>    | DISTRIBUTOR                |
| E <sub>1</sub>  | ENGINE GROUND               | THW               | WATER TEMP. SENSOR         |
| NSW             | NEUTRAL START SWITCH        | * HT <sub>2</sub> | OXYGEN SENSOR HEATER (SUB) |
| V <sub>f</sub>  | CHECK CONNECTOR             | V <sub>c</sub>    | AIR FLOW METER             |
| F <sub>pu</sub> | FUEL PRESSURE CONTROL VSV   | E <sub>21</sub>   | SENSOR GROUND              |
| W               | CHECK ENGINE WARNING LIGHT  | V <sub>s</sub>    | AIR FLOW METER             |
| AS              | AS VSV                      | 4WD               | 4WD SWITCH                 |
| T               | CHECK CONNECTOR             | THA               | AIR TEMP. SENSOR           |
| * EGR           | EGR VSV                     | SPD               | SPEED SENSOR               |
| IDL             | THROTTLE POSITION SENSOR    | BATT              | BATTERY + B                |
| HT <sub>1</sub> | OXYGEN SENSOR HEATER (MAIN) | STP               | STOP LIGHT SWITCH          |
| IGf             | IGNITER                     | +B <sub>1</sub>   | MAIN RELAY                 |
| E <sub>1</sub>  | SENSOR GROUND               | +B                | MAIN RELAY                 |

\*: California only

|                    |     |                |                |                 |     |                 |                |                 |                 |     |     |                |                 |                |                |     |      |     |                 |
|--------------------|-----|----------------|----------------|-----------------|-----|-----------------|----------------|-----------------|-----------------|-----|-----|----------------|-----------------|----------------|----------------|-----|------|-----|-----------------|
| E <sub>01</sub> NO | STA | STJ            | NSW            | F <sub>pu</sub> | W   | T               | IDL            | IG              | O <sub>x1</sub> | THG | KNK | N <sub>e</sub> | HT <sub>2</sub> | V <sub>c</sub> | V <sub>s</sub> | THA | BATT | STP | +B <sub>1</sub> |
| E <sub>02</sub> NO | IGf | E <sub>1</sub> | V <sub>f</sub> | AS              | EGR | HT <sub>1</sub> | E <sub>2</sub> | O <sub>x2</sub> | V <sub>cc</sub> | VTA | THW |                |                 |                |                |     |      |     |                 |



## • BATT – E<sub>1</sub>

① There is no voltage between ECU terminals BATT and E<sub>1</sub>.

② Check that there is voltage between ECU terminal BATT and body ground.

③ Check wiring between ECU terminal E<sub>1</sub> and body ground.

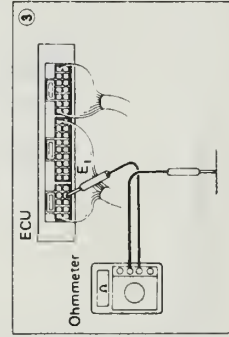
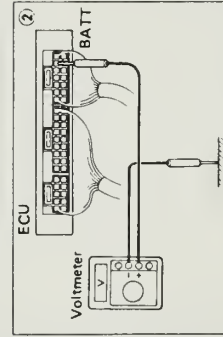
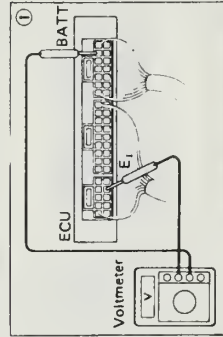
Check fuse and fusible link.

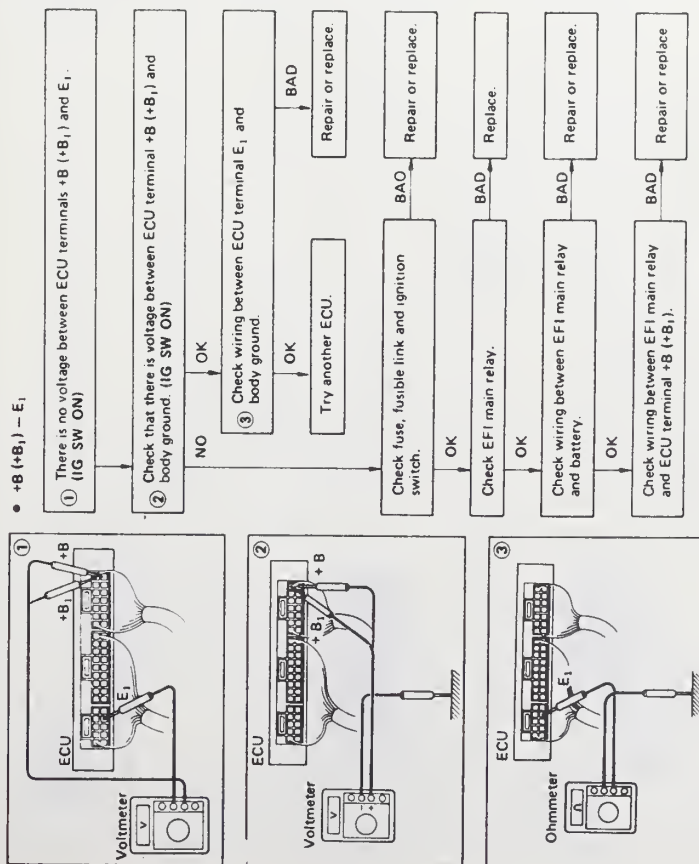
Check wiring between fuse and ECU.

Repair or replace.

Replace.

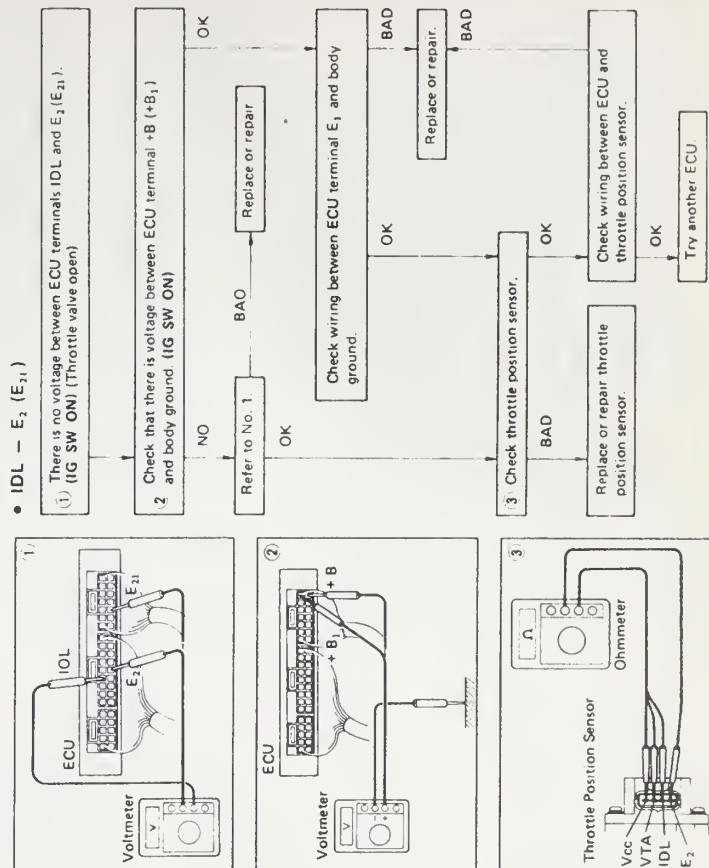
Repair or replace.

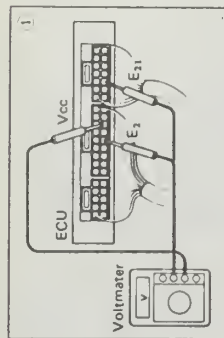




| No. | Terminals                               | Trouble    | Condition                   | STD Voltage |
|-----|-----------------------------------------|------------|-----------------------------|-------------|
| 2   | IDL — E <sub>2</sub> (E <sub>21</sub> ) | No voltage | Throttle valve open         | 8 — 14 V    |
|     | Vcc — E <sub>2</sub> (E <sub>21</sub> ) |            | Ignition switch ON          | 4 — 6 V     |
|     | VTA — E <sub>2</sub> (E <sub>21</sub> ) |            | Throttle valve fully closed | 0.1 — 1.0 V |
|     |                                         |            | Throttle valve fully open   | 3 — 5 V     |

Throttle Position Sensor

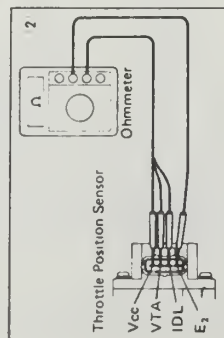




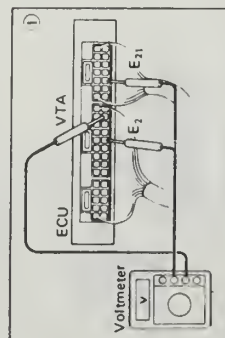
- $V_{cc} - E_2$  (E<sub>31</sub>)
- 1. There is no voltage between ECU terminals Vcc and E<sub>2</sub> (E<sub>31</sub>). (IG SW ON)
- Check that there is voltage between ECU terminals +B (+B<sub>1</sub>) and E<sub>1</sub>. (IG SW ON)

OK → 2. Check throttle position sensor.

NO → Refer to No. 1.



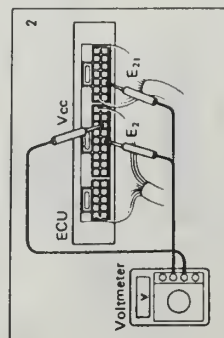
- 2. Check throttle position sensor.
- OK → Check wiring between ECU and throttle position sensor.
- OK → Try another ECU.
- BAD → Repair or replace.
- BAD → Repair or replace wiring.



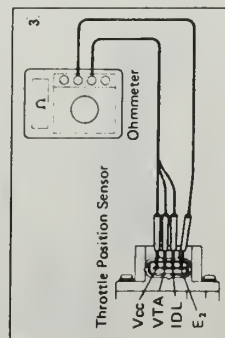
- $V_{TA} - E_2$  (E<sub>31</sub>)
- 1. There is no specified voltage between ECU terminals VTA and E<sub>2</sub> (E<sub>31</sub>). (IG SW ON)
- 2. Check that there is voltage between ECU terminals Vcc and E<sub>2</sub> (E<sub>31</sub>). (IG SW ON)

OK → 3. Check throttle position sensor.

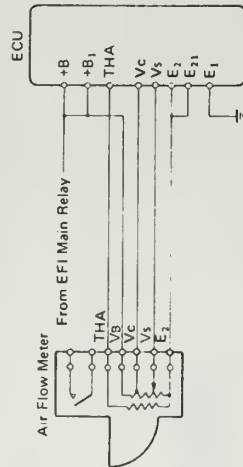
NO → Perform inspection of Vcc - E<sub>2</sub> (E<sub>31</sub>).



- 3. Check throttle position sensor.
- OK → Check wiring between ECU and throttle position sensor.
- OK → Try another ECU.
- BAD → Repair or replace.
- BAD → Repair or replace throttle position sensor.



| No. | Terminals                         | Trouble    | Condition                          | STD Voltage |
|-----|-----------------------------------|------------|------------------------------------|-------------|
| 3   | $V_{cc} - E_2$ (E <sub>31</sub> ) | No voltage | Ignition switch ON                 | 6 - 10 V    |
|     | $V_s - E_2$ (E <sub>31</sub> )    |            | Measuring plate fully closed       | 0.5 - 2.5 V |
|     |                                   |            | Measuring plate fully open         | 5 - 10 V    |
|     | $THA - E_2$ (E <sub>31</sub> )    |            | Idling                             | 2 - 8 V     |
|     |                                   |            | Intake air temperature 20°C (68°F) | 1 - 3 V     |



- $V_c - E_2$  (E<sub>31</sub>)

1. There is no voltage between ECU terminals Vc and E<sub>2</sub> (E<sub>31</sub>). (IG SW ON)

2. Check that there is voltage between ECU terminals +B (+B<sub>1</sub>) and E<sub>1</sub>. (IG SW ON)

OK → 3. Check air flow meter.

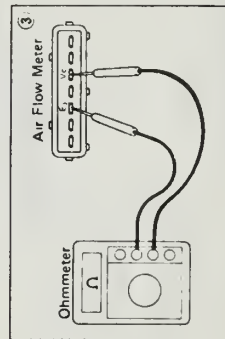
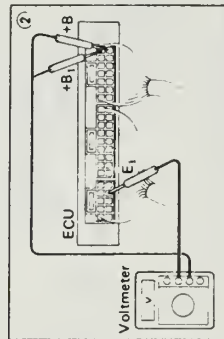
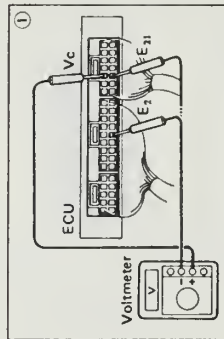
NO → Refer to No. 1.

OK → Check wiring between ECU and air flow meter.

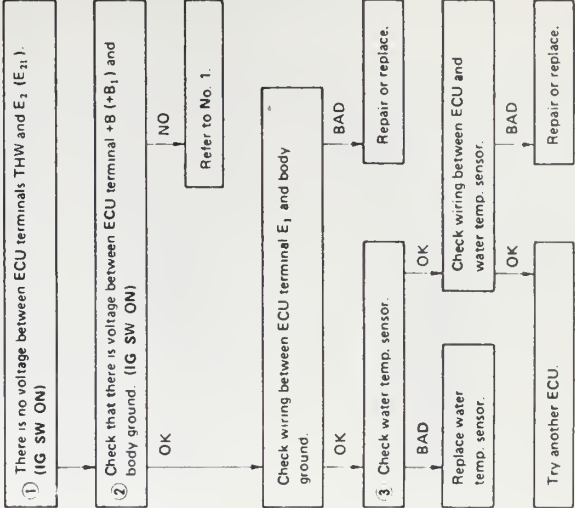
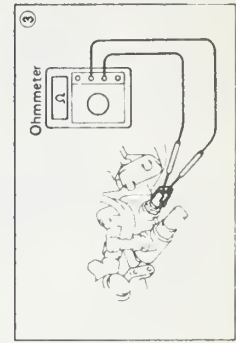
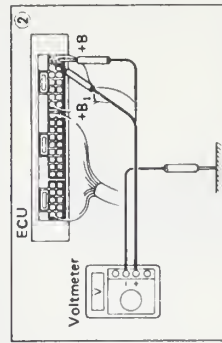
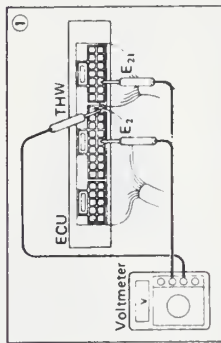
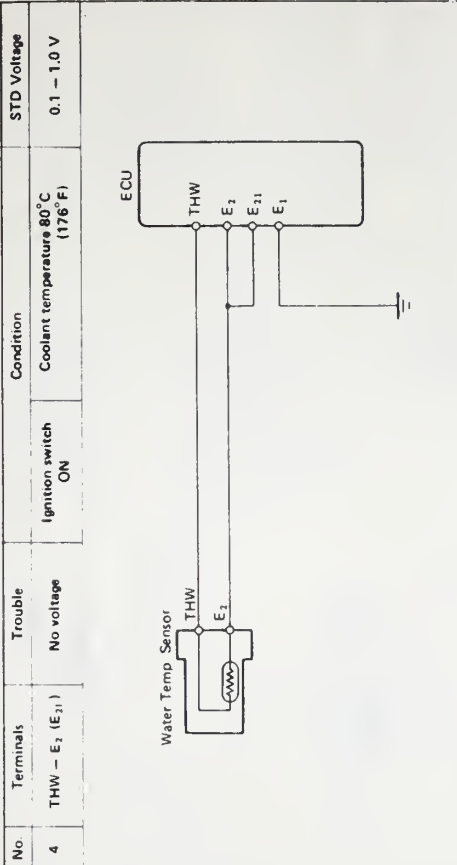
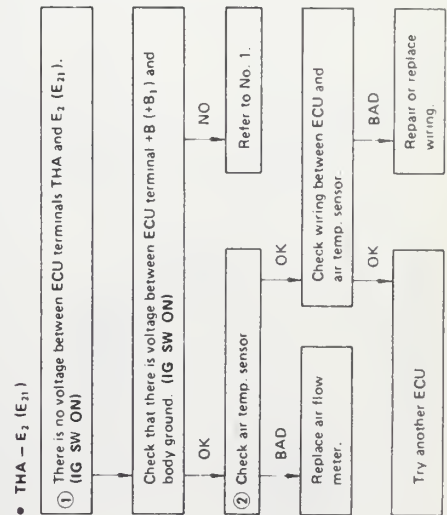
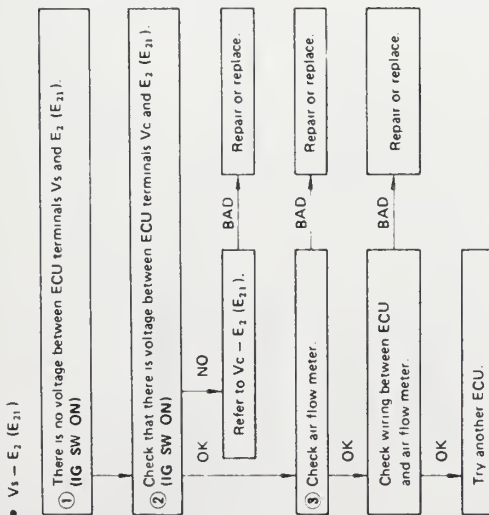
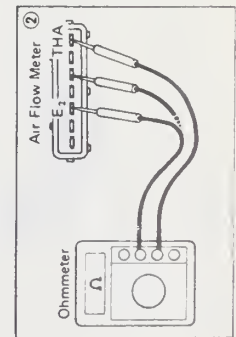
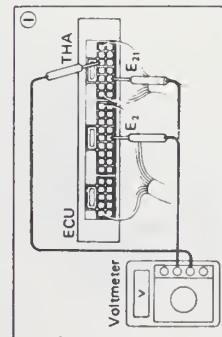
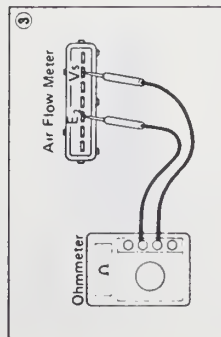
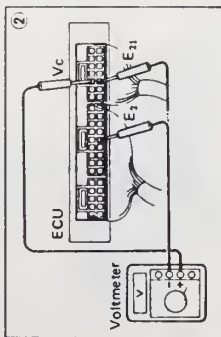
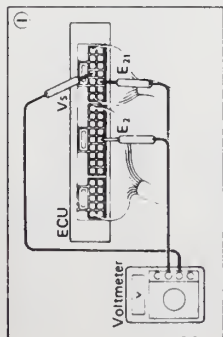
BAD → Replace or repair air flow meter.

OK → Try another ECU.

BAD → Replace or repair wiring.



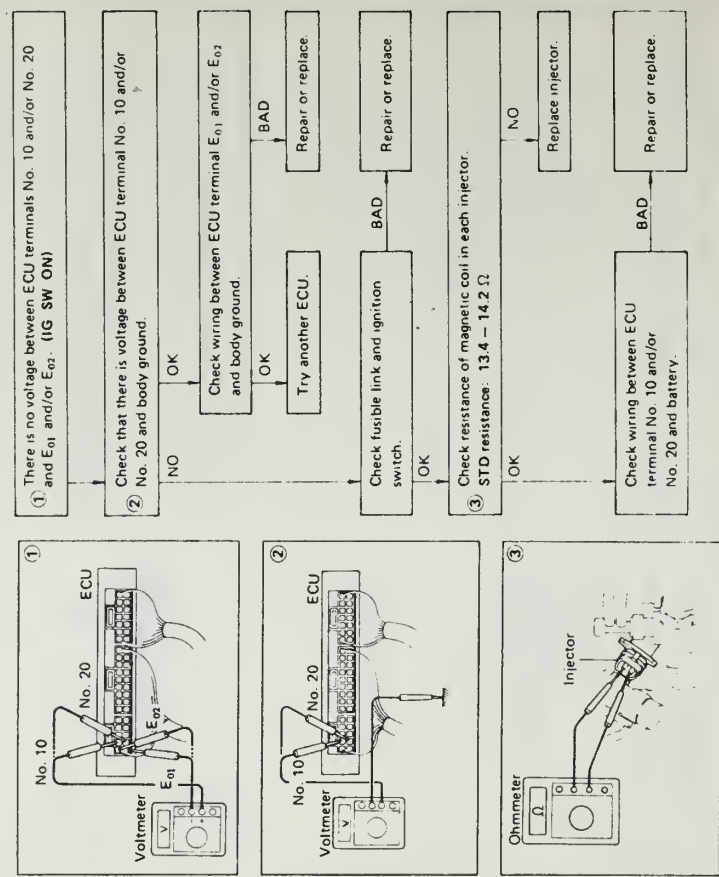
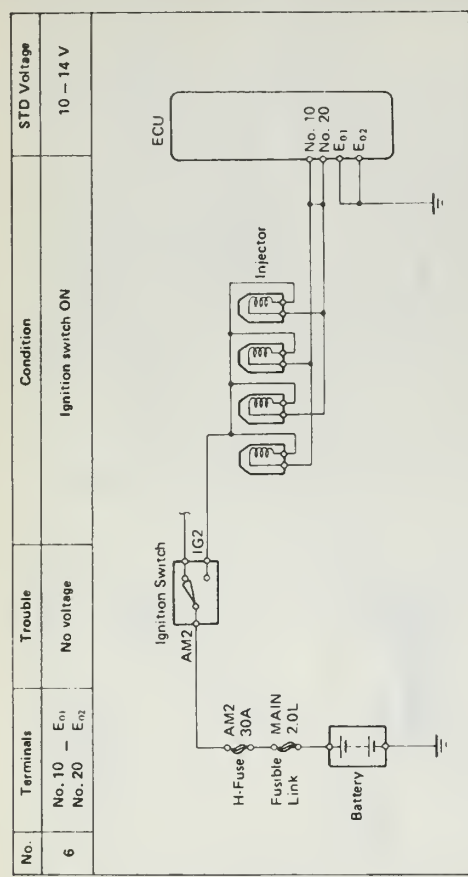
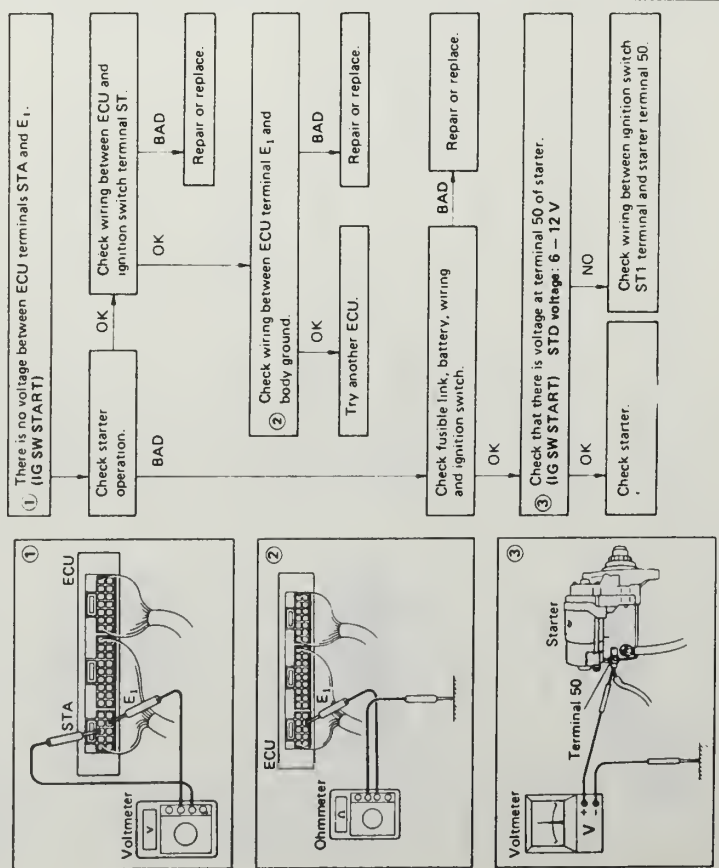
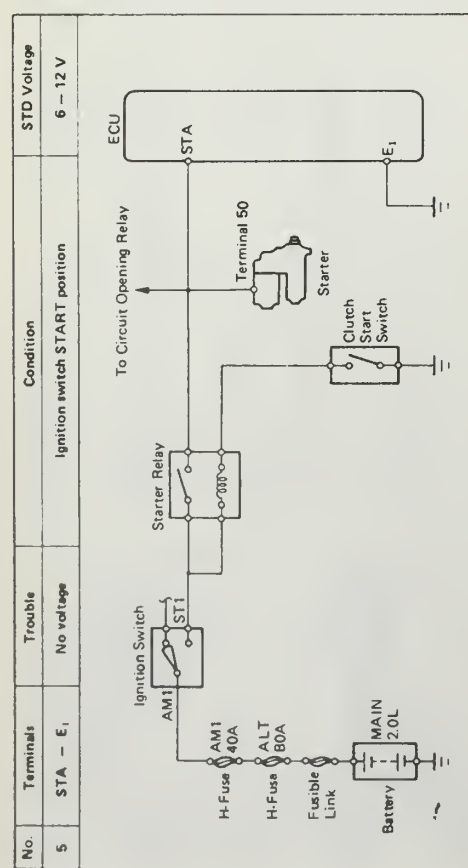




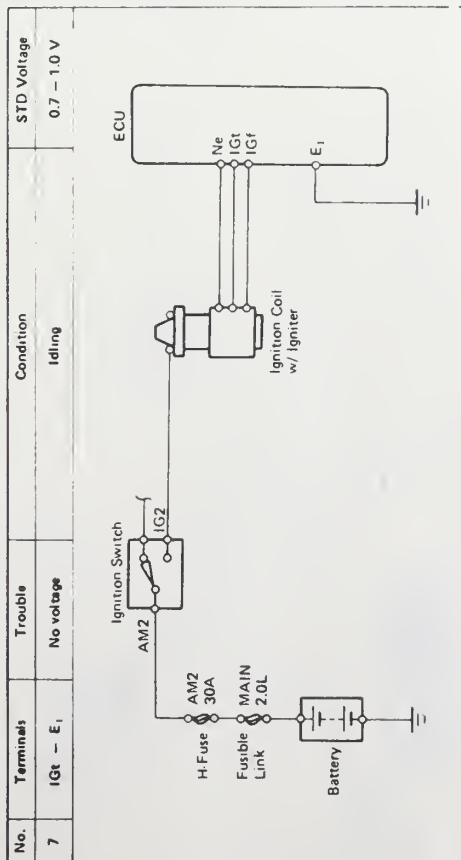
# ECU TEST NO. 5 – 1991 TRUCKS WITH 22R-E, 4WD, MANUAL TRANS

# ECU TEST NO. 6 – 1991 TRUCKS WITH 22R-E, 4WD, MANUAL TRANS

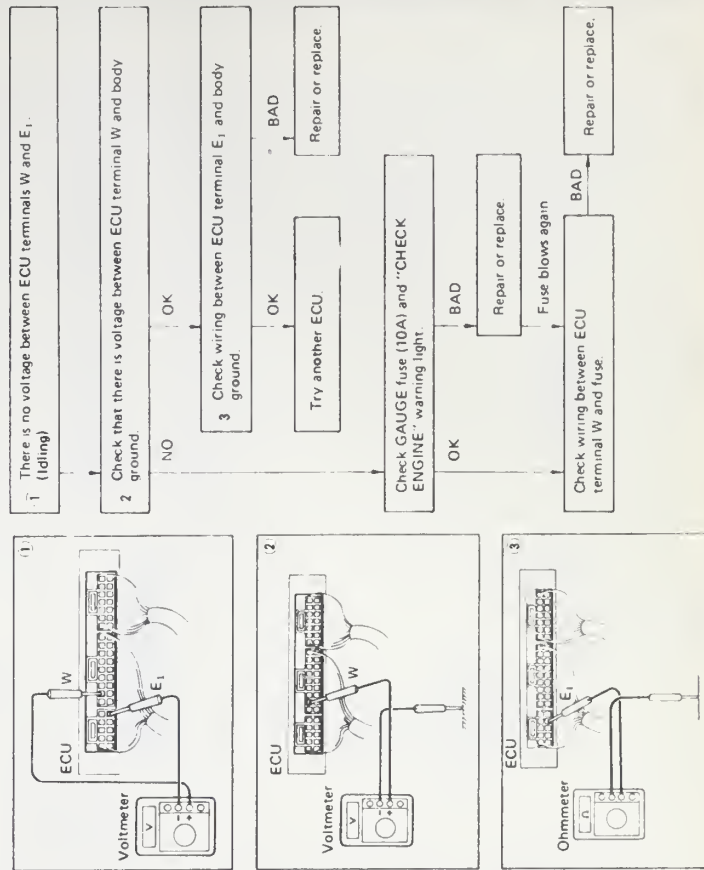
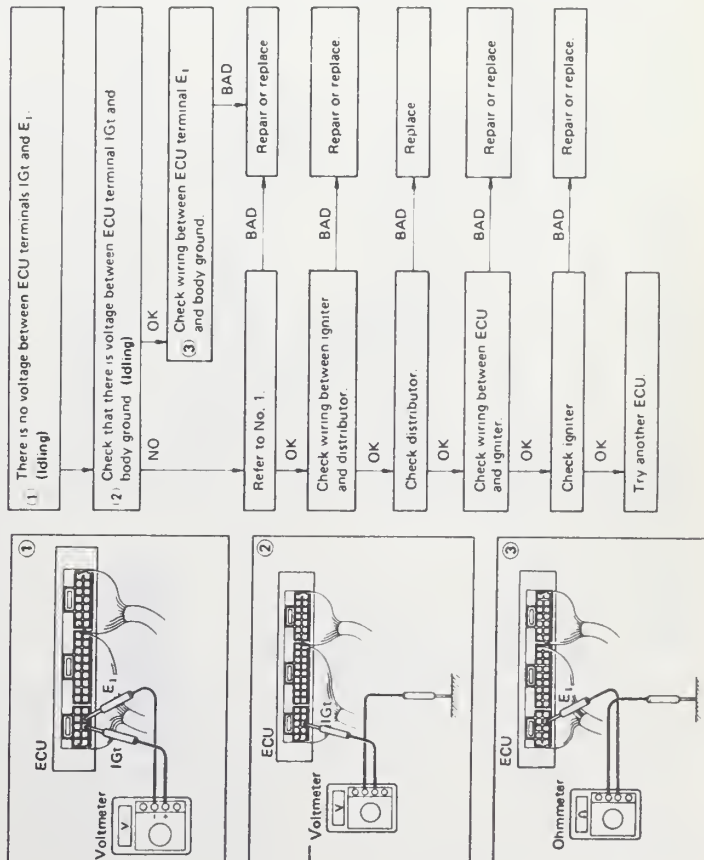
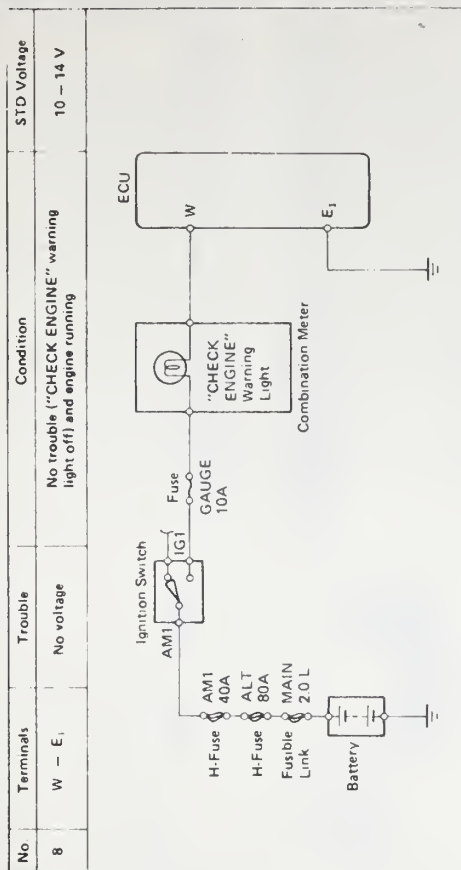
# 5 FUEL SYSTEM



# ECU TEST NO. 7 — 1991 TRUCKS WITH 22R-E, 4WD, MANUAL TRANS



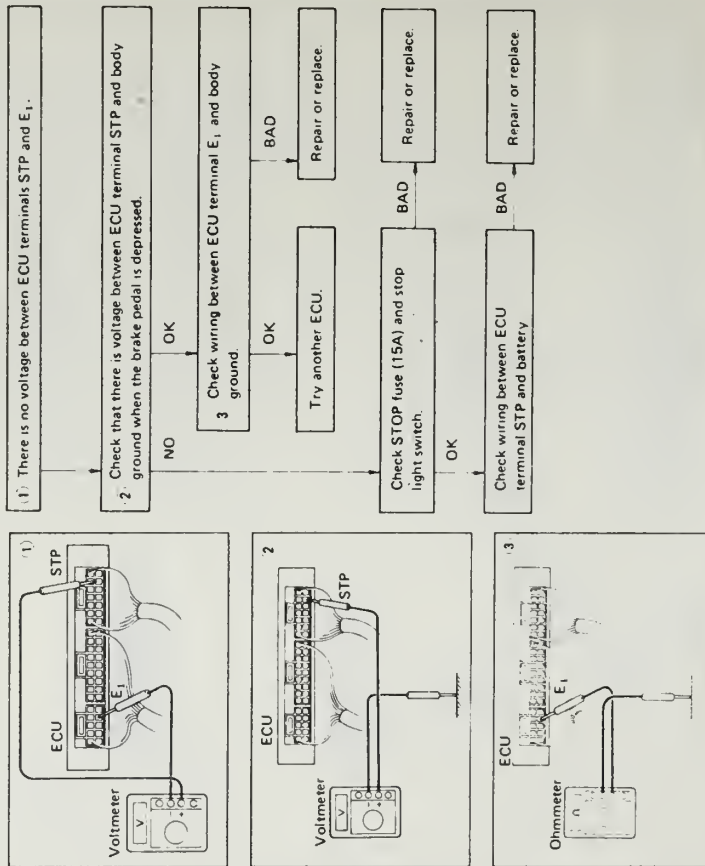
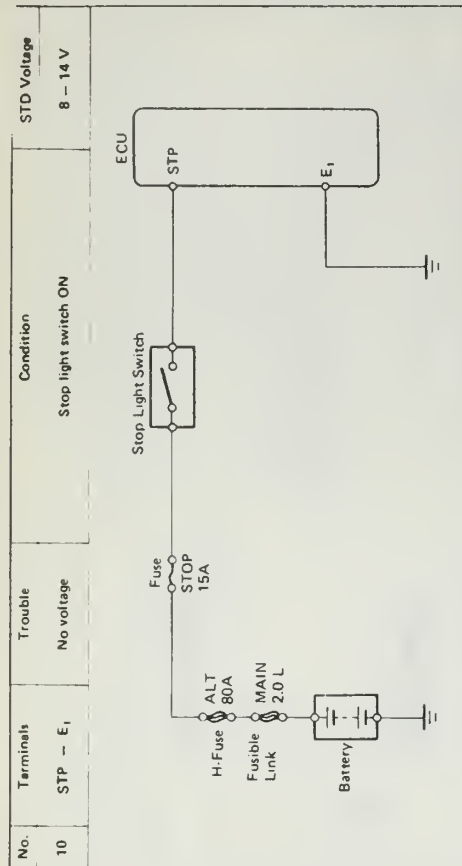
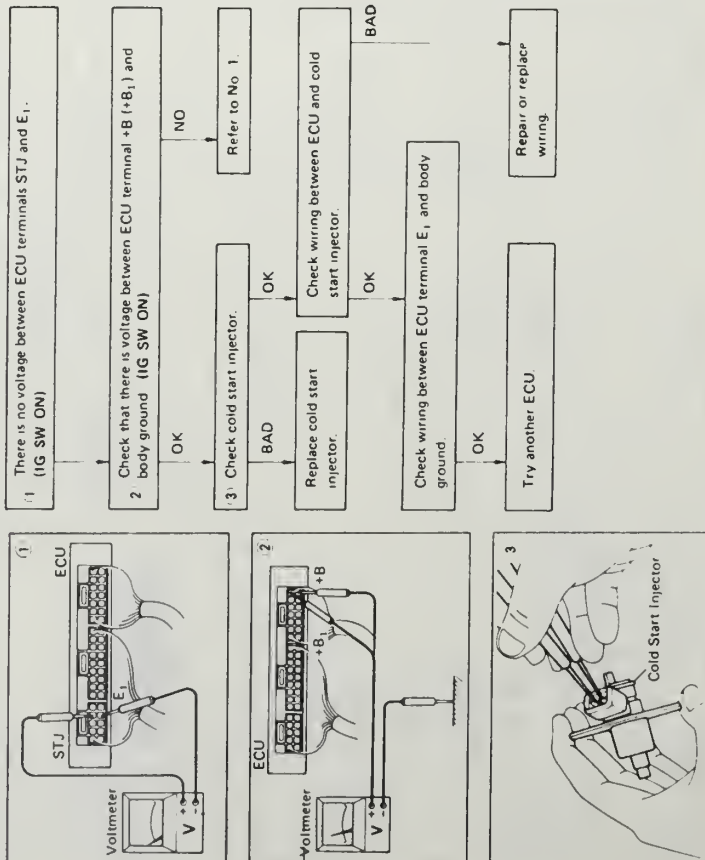
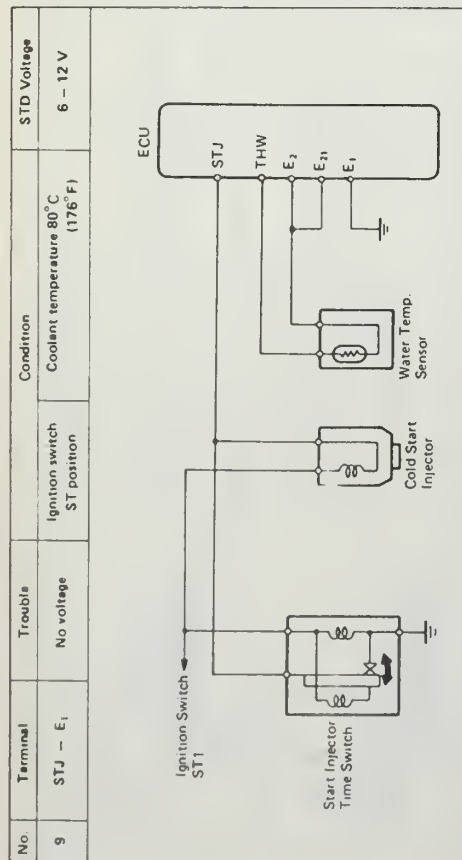
# ECU TEST NO. 8 — 1991 TRUCKS WITH 22R-E, 4WD, MANUAL TRANS

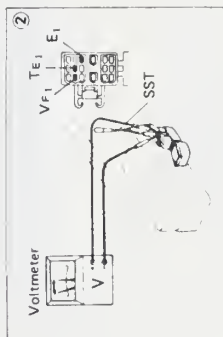
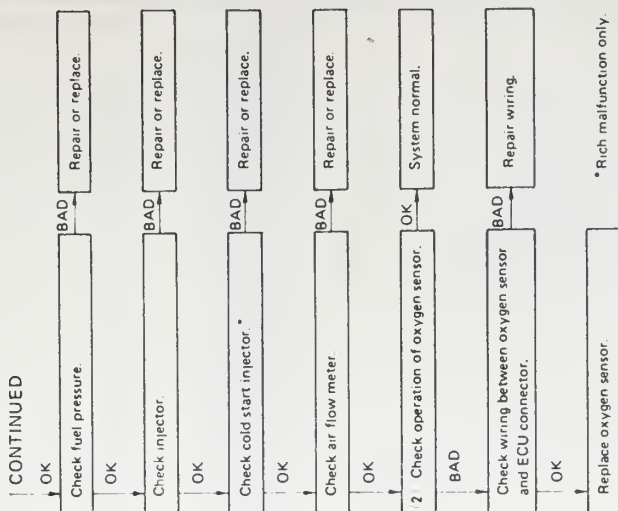
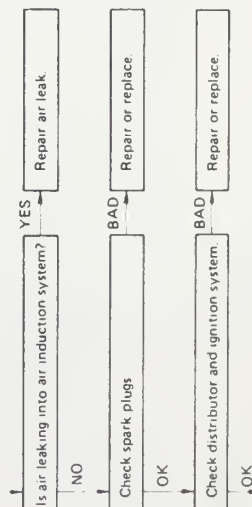
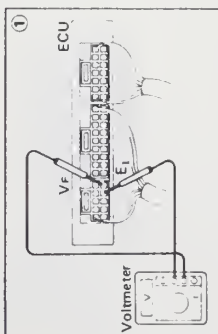
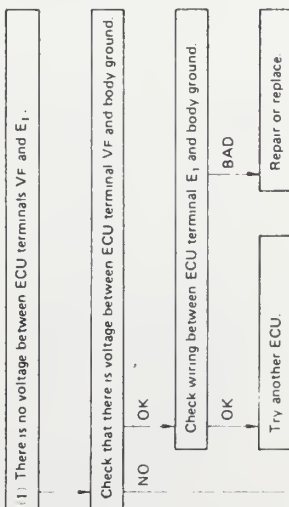
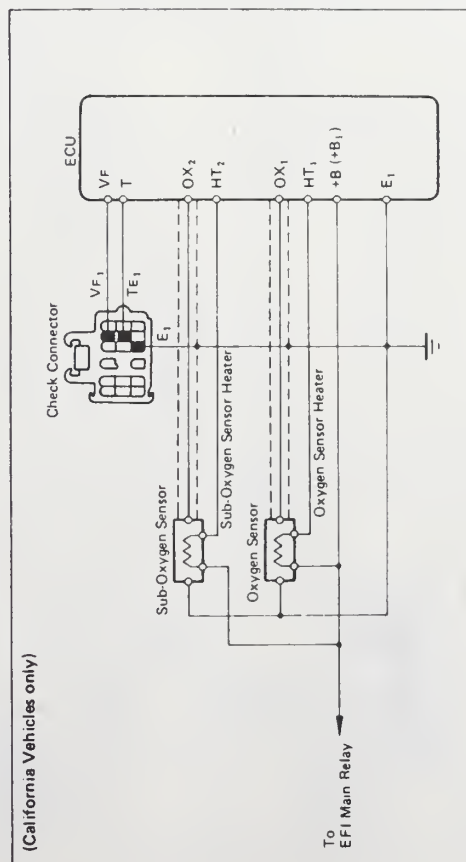




# ECU TEST NO. 9 — 1991 TRUCKS WITH 22R-E, 4WD, MANUAL TRANS

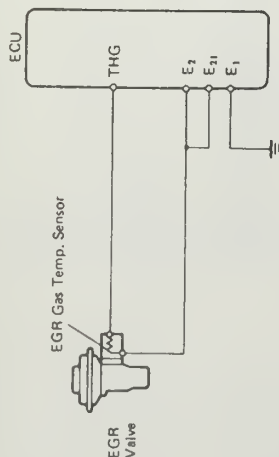
# ECU TEST NO. 10 — 1991 TRUCKS WITH 22R-E, 4WD, MANUAL TRANS





## EGR GAS TEMPERATURE SENSOR SIGNAL TEST – 1991 TRUCKS WITH 22R-E, 4WD, MANUAL TRANS

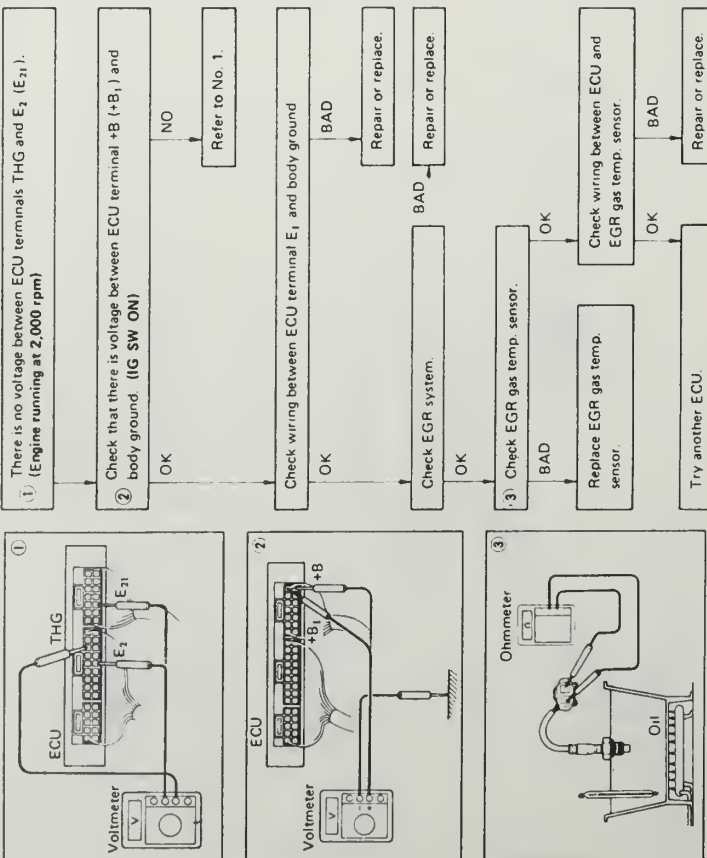
(California Vehicles only)



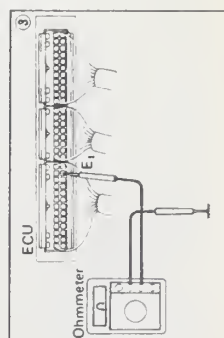
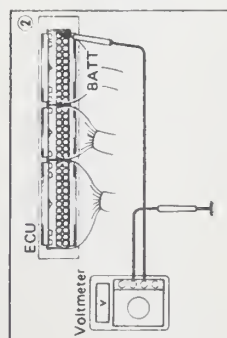
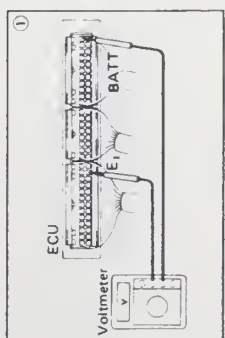
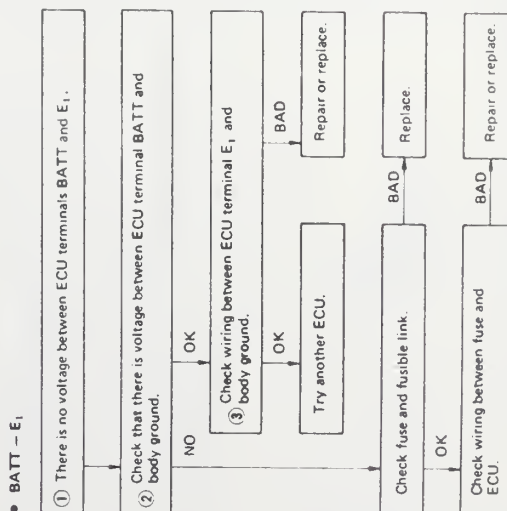
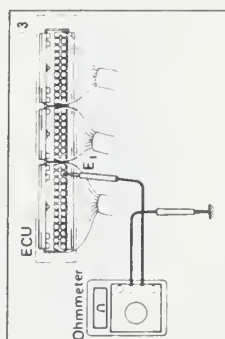
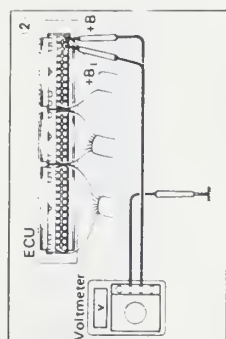
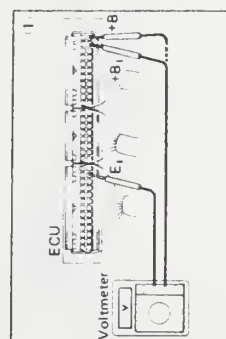
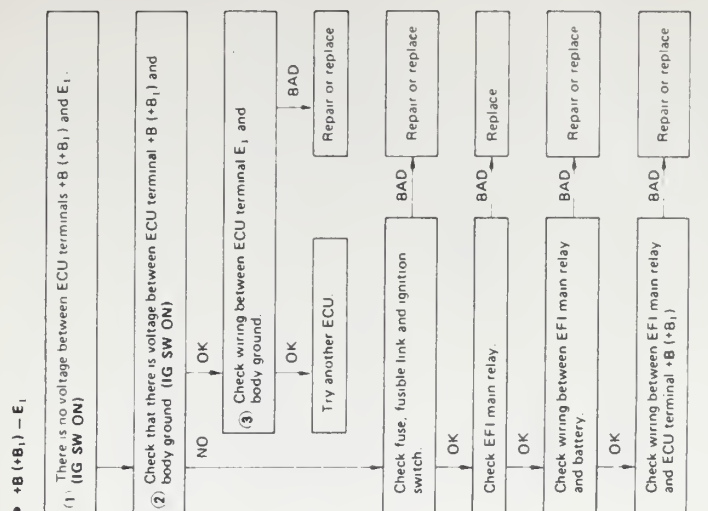
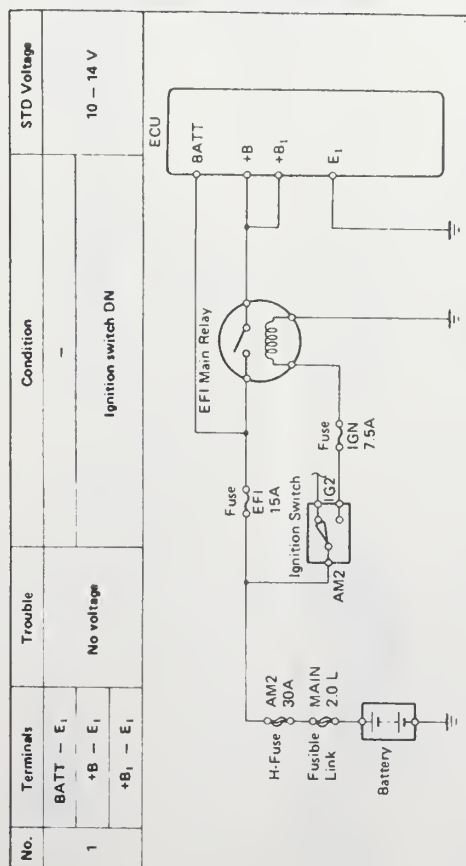
## ECU TERMINALS – 1991 TRUCKS WITH 22R-E, 4WD, AUTO. TRANS

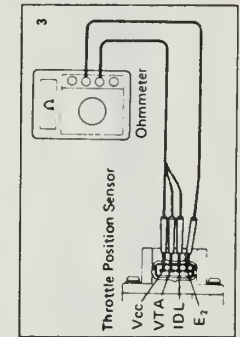
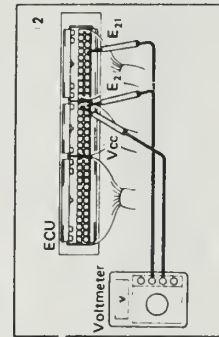
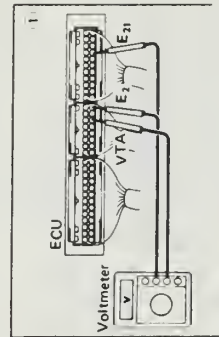
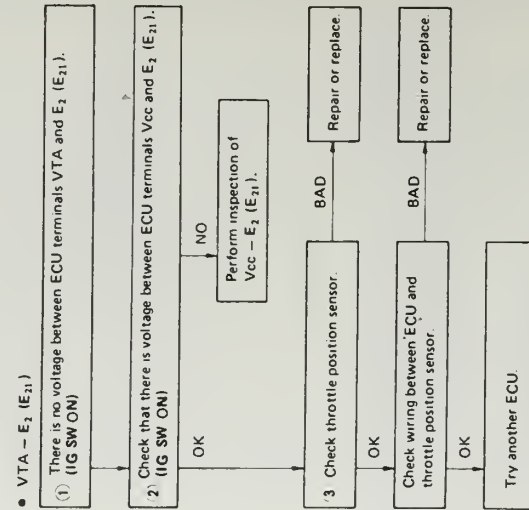
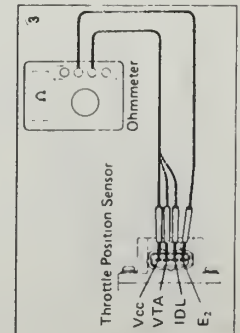
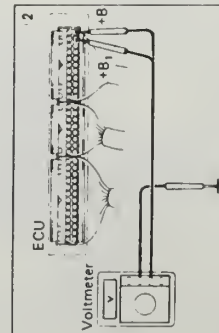
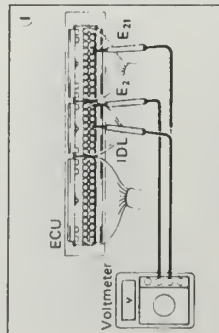
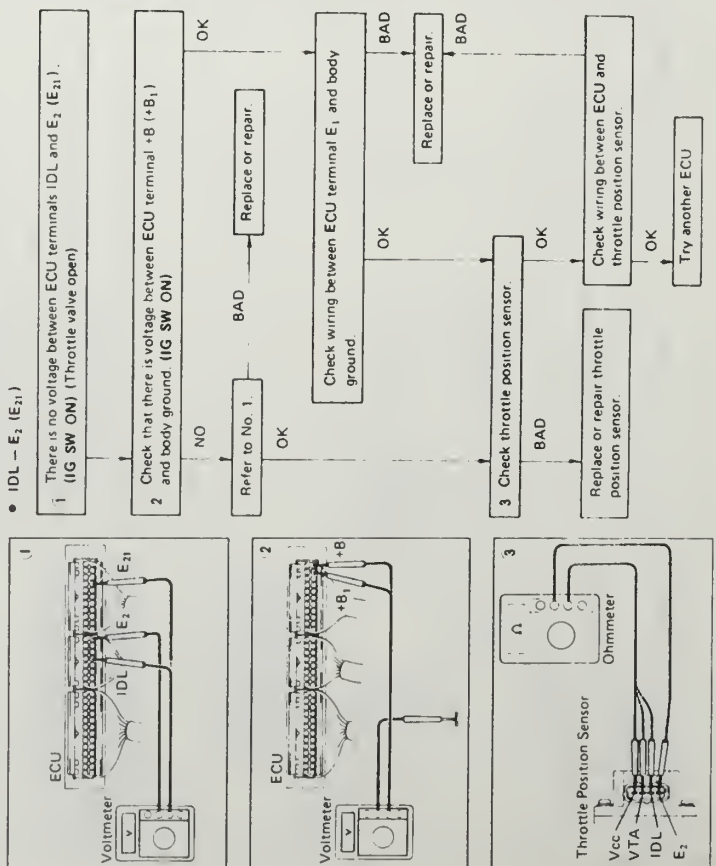
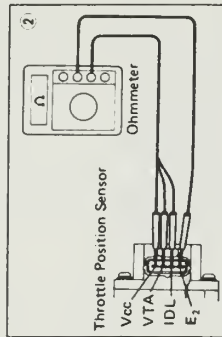
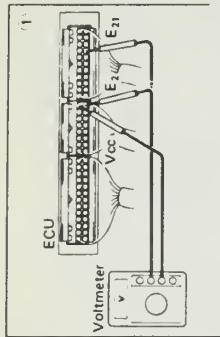
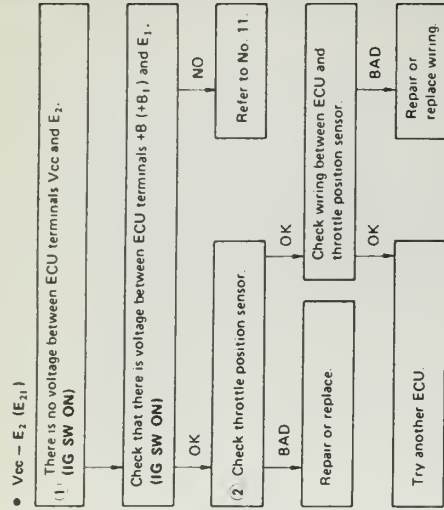
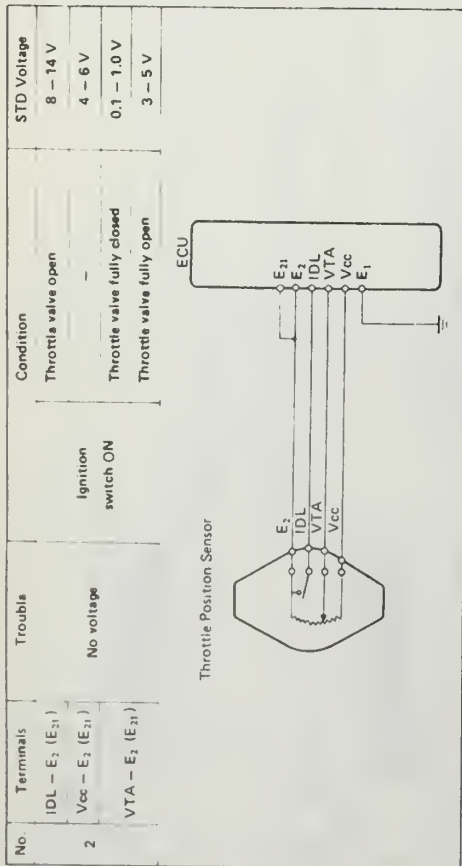
| Symbol | Terminal Name               | Symbol | Terminal Name               |
|--------|-----------------------------|--------|-----------------------------|
| E01    | ENGINE GROUND               | * Ox1  | OXYGEN SENSOR (SUB)         |
| E02    | ENGINE GROUND               | KNK    | KNOCK SENSOR                |
| No. 10 | INJECTOR                    | * THG  | EGR GAS TEMP. SENSOR        |
| No. 20 | INJECTOR                    | THW    | WATER TEMP. SENSOR          |
| Fpu    | FUEL PRESSURE CONTROL VSV   | IDL    | THROTTLE POSITION SENSOR    |
| HT1    | OXYGEN SENSOR HEATER (MAIN) | THA    | AIR TEMP. SENSOR            |
| AS     | AS VSV                      | VTA    | THROTTLE POSITION SENSOR    |
| * HT2  | OXYGEN SENSOR HEATER (SUB)  | Vc     | AIR FLOW METER              |
| * EGR  | EGR VSV                     | Vs     | AIR FLOW METER              |
| IGt    | IGNITER                     | Vcc    | THROTTLE POSITION SENSOR    |
| S1     | ECT SOLENOID                | E2     | SENSOR GROUND               |
| L4     | TRANSFER POSITION SWITCH    | STA    | STARTER SWITCH              |
| S2     | ECT SOLENOID                | OD1    | CRUISE CONTROL COMPUTER     |
| N      | NEUTRAL START SWITCH        | SPD1   | SPEED SENSOR                |
| S3     | ECT SOLENOID                | DG     | CHECK CONNECTOR             |
| 2      | NEUTRAL START SWITCH        | 4WD    | 4WD SWITCH                  |
| L      | NEUTRAL START SWITCH        | P      | PATTERN SELECT SWITCH       |
| IGf    | IGNITER                     | STP    | STOP LIGHT SWITCH           |
| SPD2   | SPEED SENSOR                | W      | CHECK ENGINE WARNING LIGHT  |
| STJ    | COLD START INJECTOR         | OD2    | CRUISE CONTROL COMPUTER     |
| E1     | ENGINE GROUND               | OIL    | A/T OIL TEMP. WARNING LIGHT |
| Ne     | DISTRIBUTOR                 | E21    | SENSOR GROUND               |
| V1     | CHECK CONNECTOR             | +B1    | MAIN RELAY                  |
| THO    | T/M OIL TEMP. SENSOR        | BATT   | BATTERY +B                  |
| T      | CHECK CONNECTOR             | +B     | MAIN RELAY                  |
| Ok1    | OXYGEN SENSOR (MAIN)        |        |                             |

\* California only

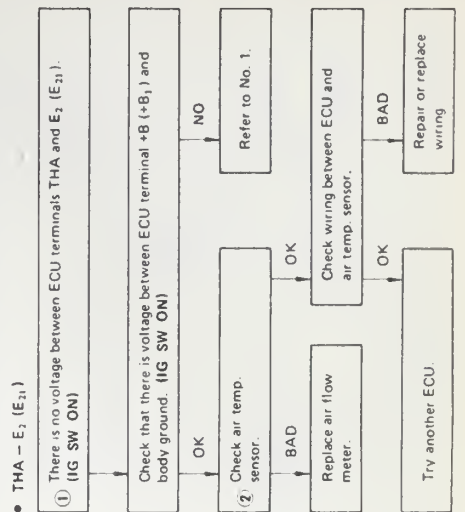
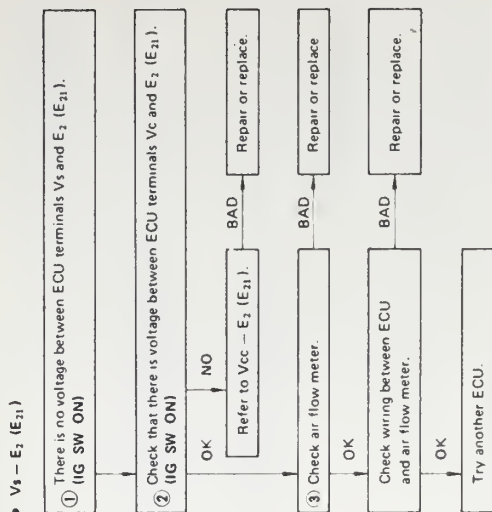
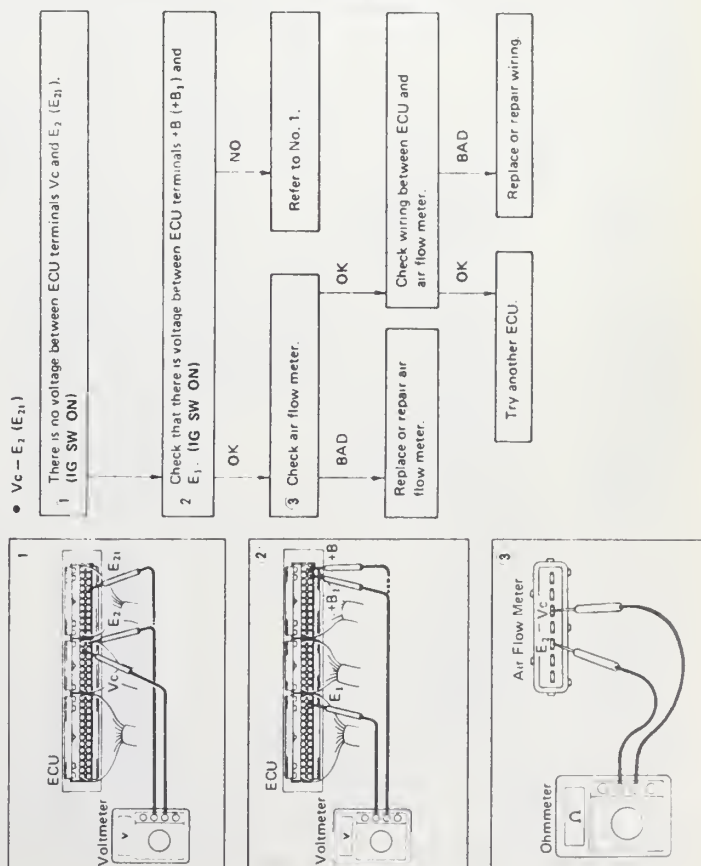








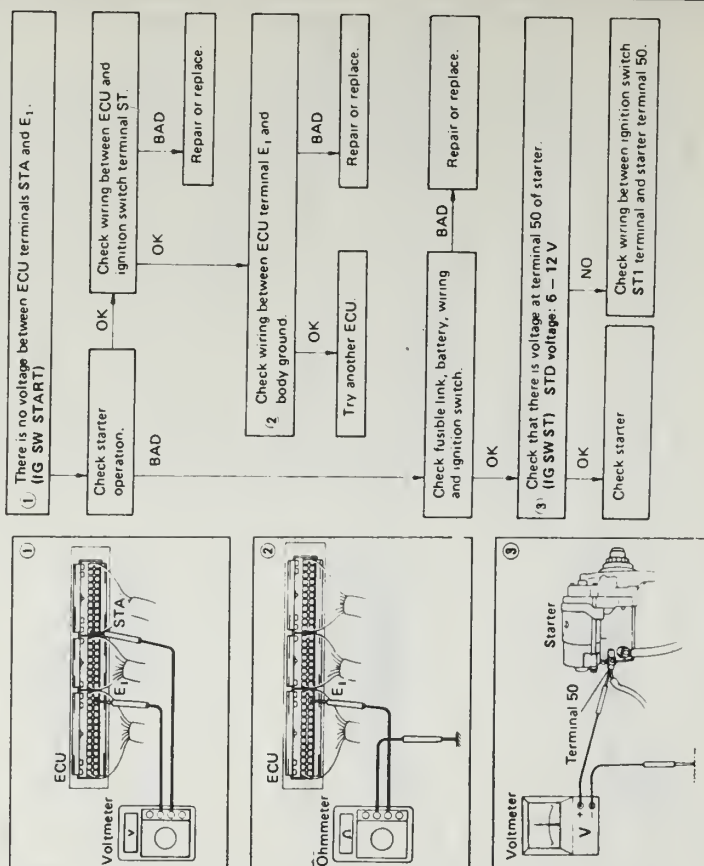
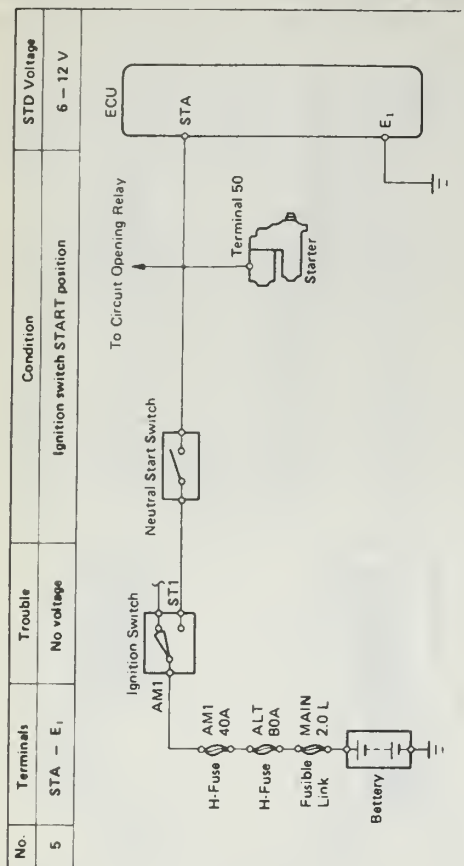
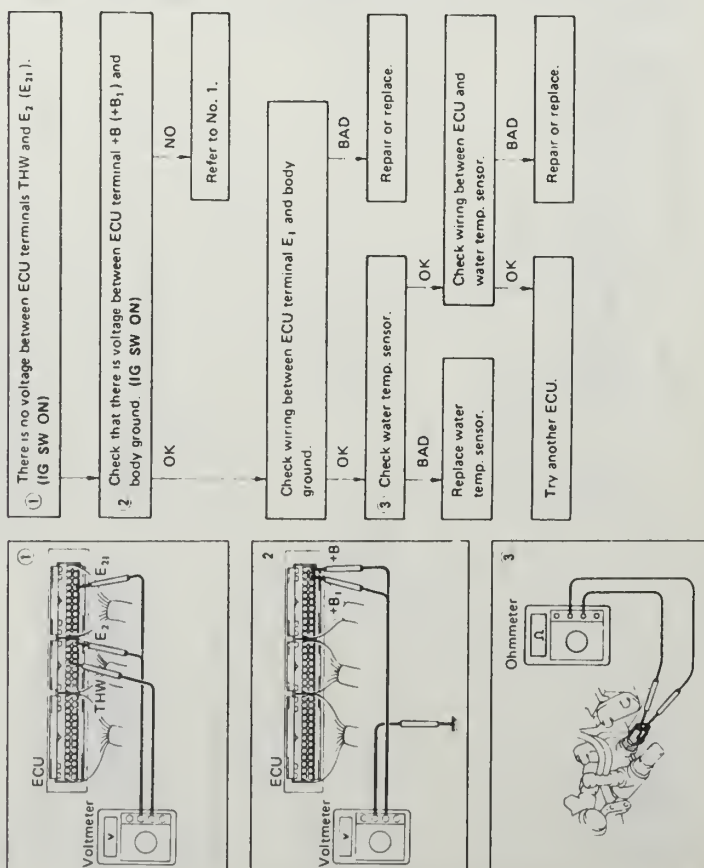
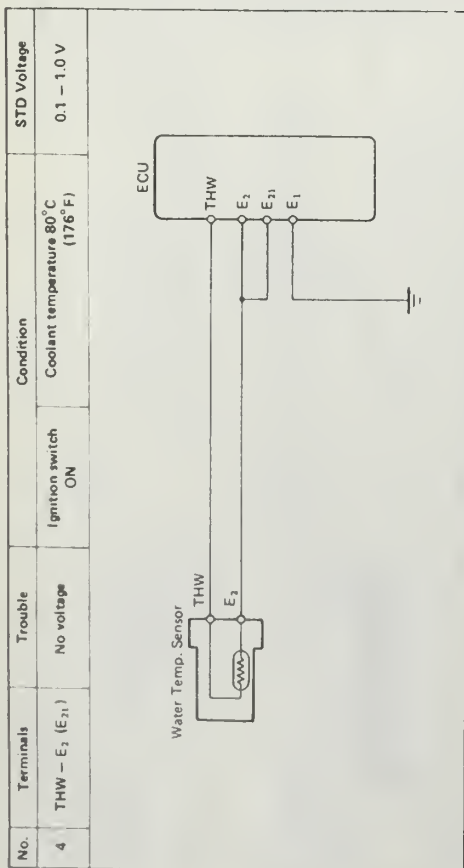
| No. | Terminals                                          | Trouble    | Condition                          | STD Voltage |
|-----|----------------------------------------------------|------------|------------------------------------|-------------|
| 3   | Vc — E <sub>2</sub> (E <sub>21</sub> )             | No voltage | Ignition switch ON                 | 6 — 10 V    |
|     | V <sub>s</sub> — E <sub>2</sub> (E <sub>21</sub> ) |            | Measuring plate fully closed       | 0.5 — 2.5 V |
|     | THA — E <sub>2</sub> (E <sub>21</sub> )            |            | Measuring plate fully open         | 5 — 10 V    |
|     |                                                    |            | Idling                             | 2 — 8 V     |
|     |                                                    |            | Intake air temperature 20°C (68°F) | 1 — 3 V     |

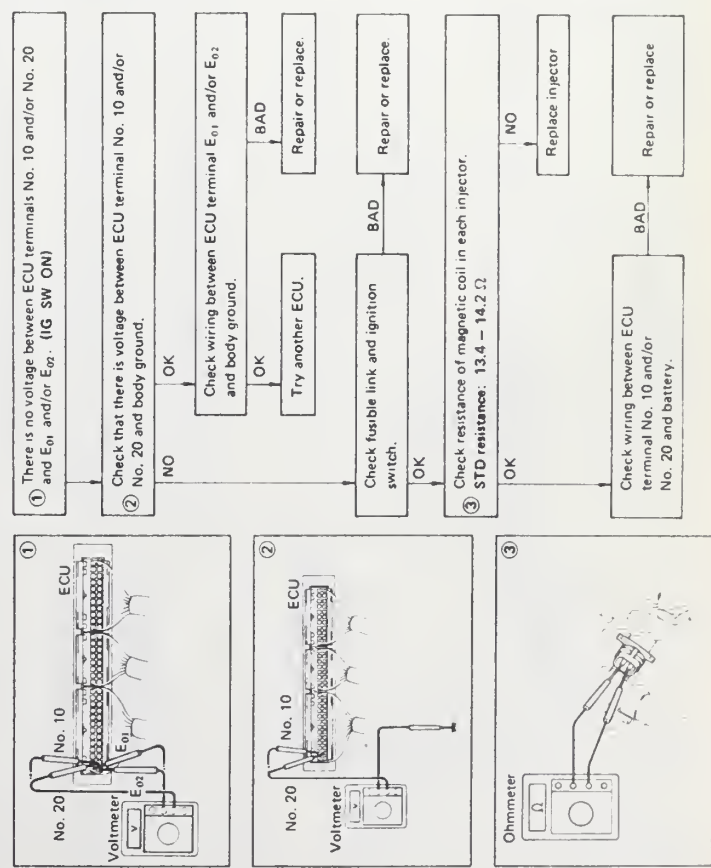
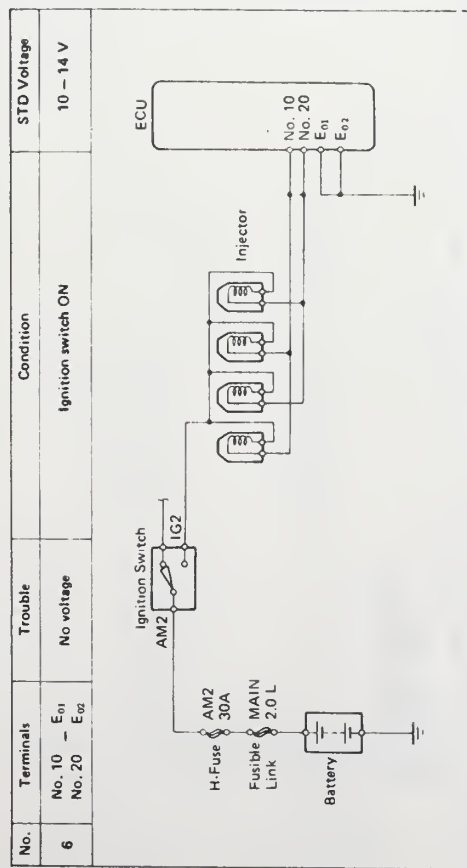


# ECU TEST NO.4 — 1991 TRUCKS WITH 22R-E, 4WD, AUTO. TRANS

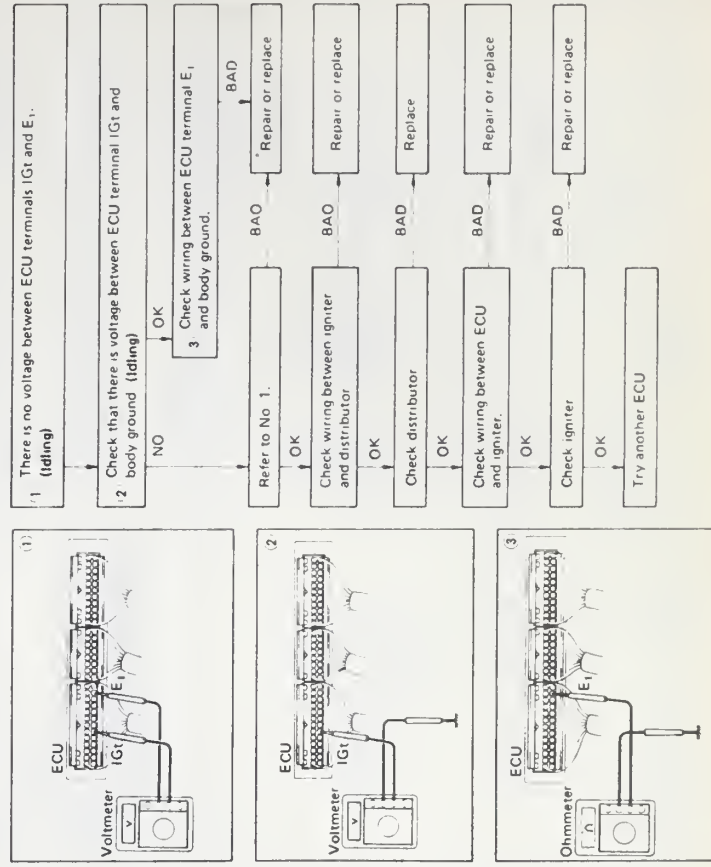
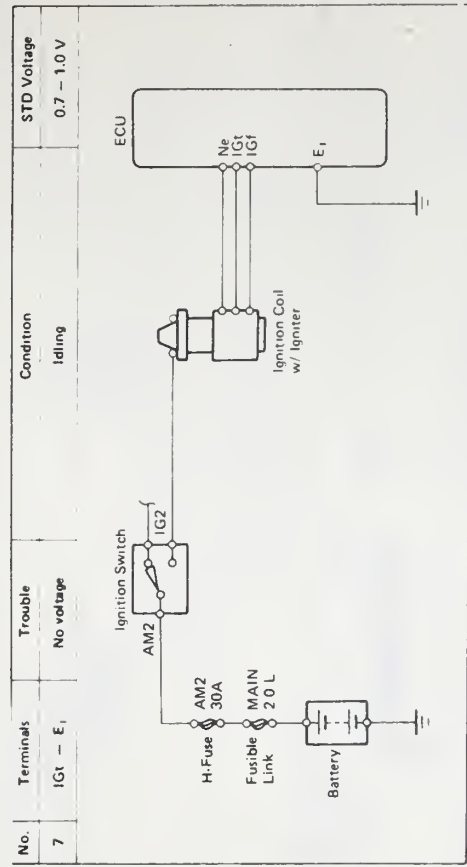
# ECU TEST NO.5 — 1991 TRUCKS WITH 22R-E, 4WD, AUTO. TRANS



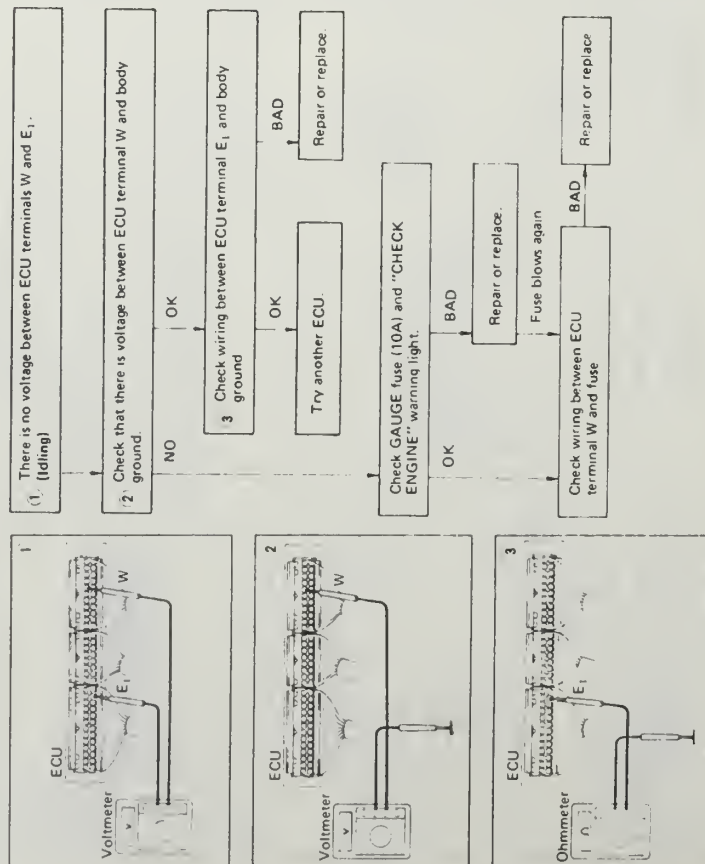
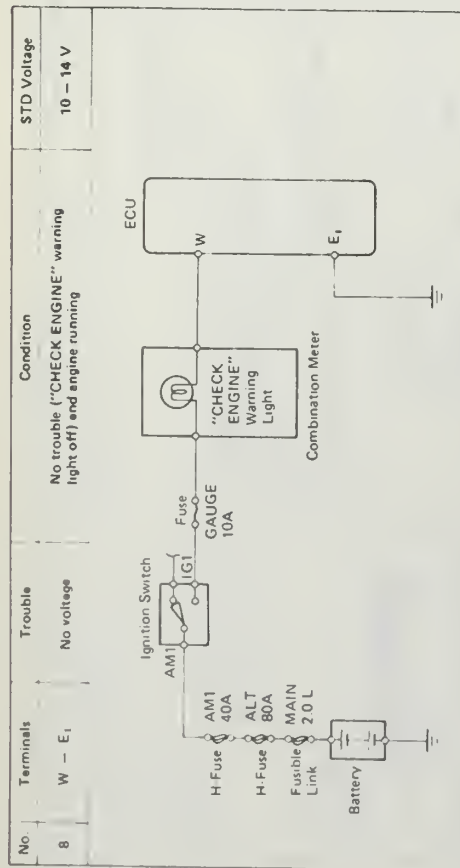
# ECU TEST NO.6 — 1991 TRUCKS WITH 22R-E, 4WD, AUTO. TRANS



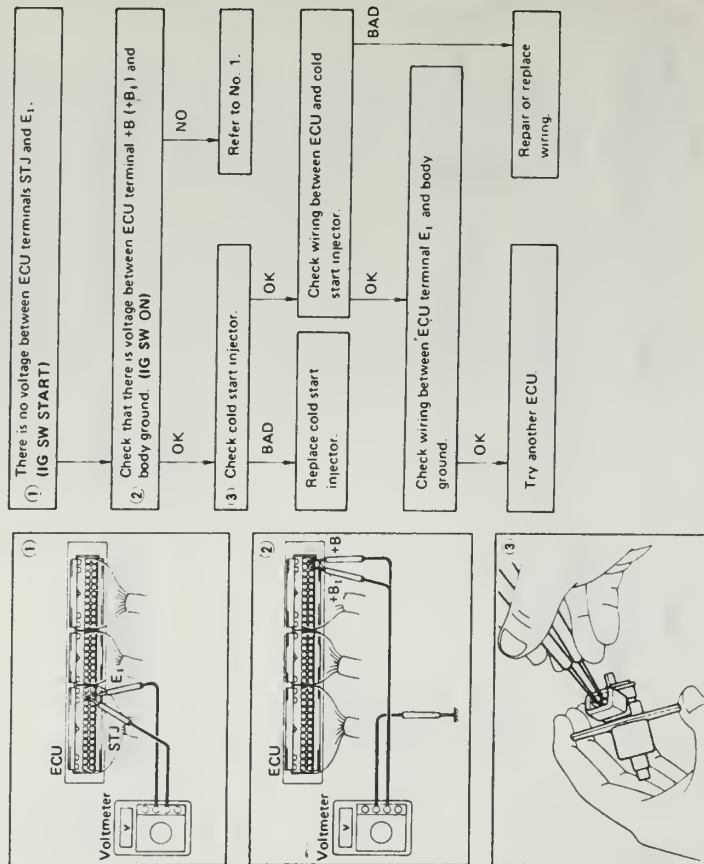
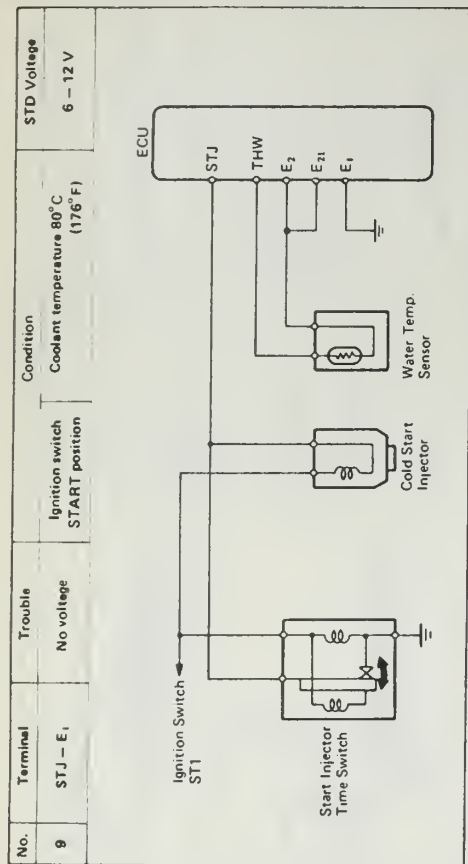
# ECU TEST NO.7 — 1991 TRUCKS WITH 22R-E, 4WD, AUTO. TRANS



## ECU TEST NO.8 — 1991 TRUCKS WITH 22R-E, 4WD, AUTO. TRANS



## ECU TEST NO.9 — 1991 TRUCKS WITH 22R-E, 4WD, AUTO. TRANS



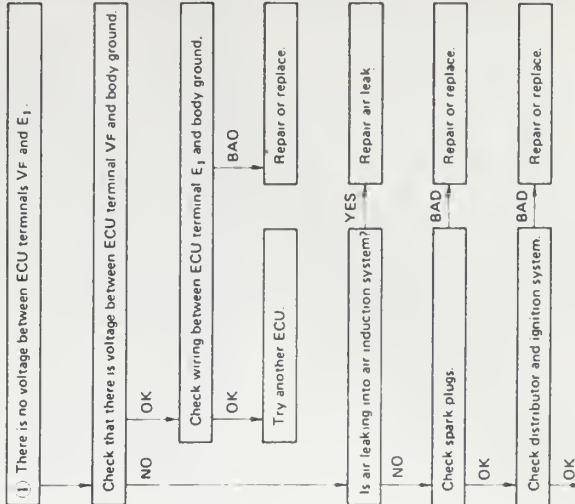
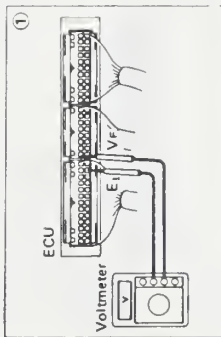
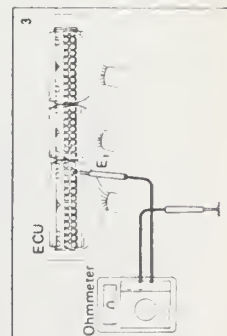
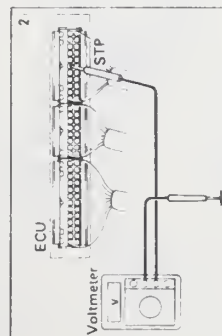
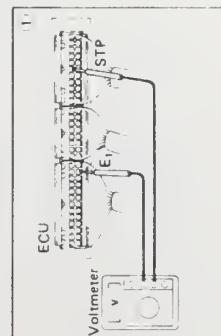
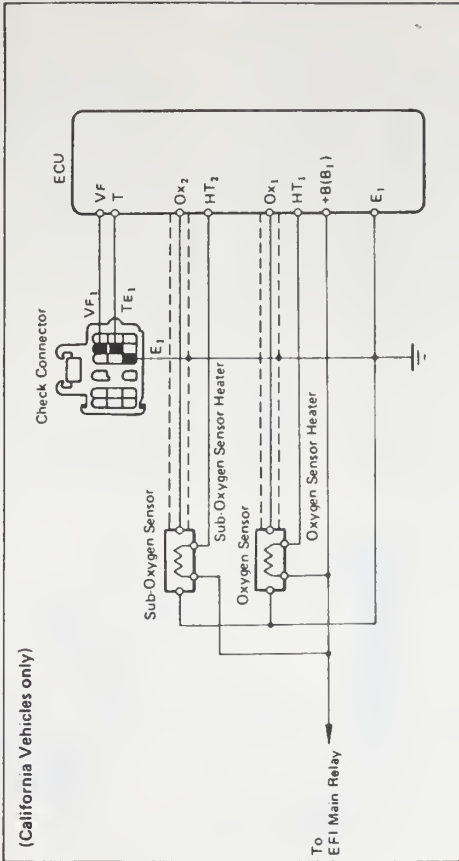


**ECU TEST NO.10 – 1991 TRUCKS WITH  
22R-E, 4WD, AUTO. TRANS**

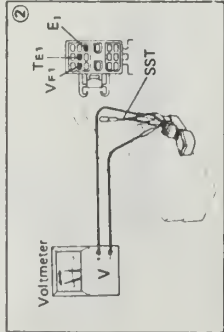
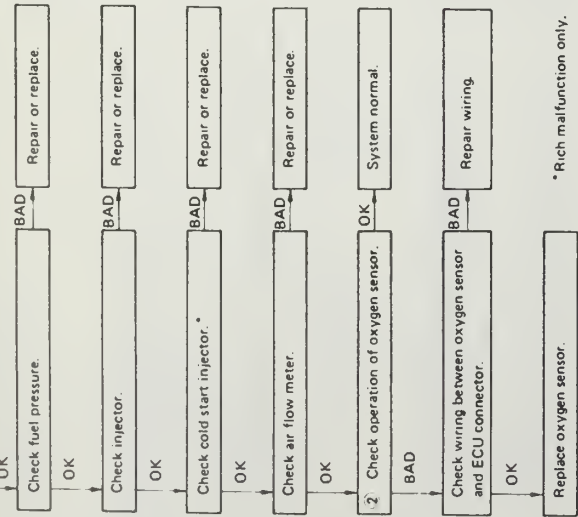
| No. | Terminals            | Trouble    | Condition            | STD Voltage |
|-----|----------------------|------------|----------------------|-------------|
| 10  | STP - E <sub>i</sub> | No voltage | Stop light switch ON | 8 - 14 V    |

The diagram illustrates the electrical circuit for the stop light switch. It begins with a battery connected to a 20L fusible link, which leads to the main terminal of an 80A H-fuse. The output of the fuse is connected to the STP terminal of the ECU. The ECU's Ei terminal is grounded. A stop light switch is connected between the STP terminal and ground, and is currently in the closed (ON) position.

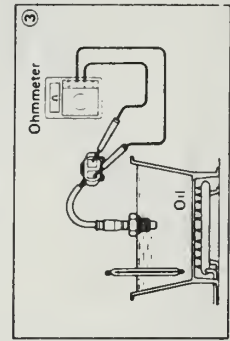
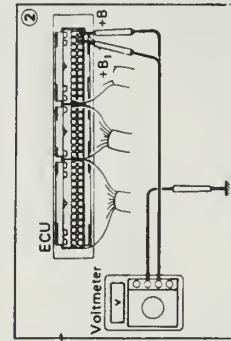
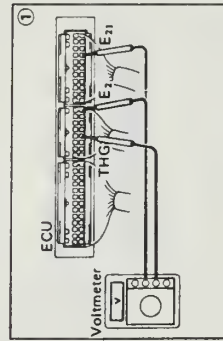
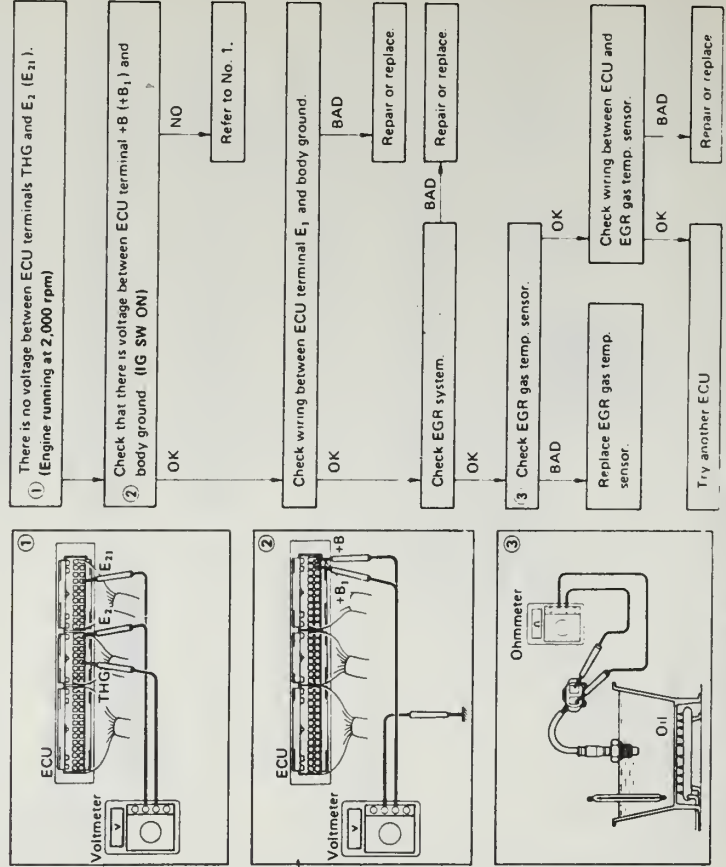
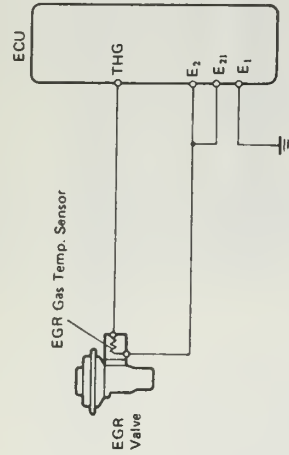


CONTINUED



\* Rich malfunction only.

(California Vehicles only)



| Code No. | Number of blinks "CHECK ENGINE" Warning Light | System                           | "CHECK ENGINE" Warning Light | Diagnosis                                                                                                                         | Trouble Area                                                                                                                                             | *2 Memory |
|----------|-----------------------------------------------|----------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 31       | — 00000000                                    | Air Flow Meter Signal            | ON                           | Open or short detected continuously for 500 msec or more in air flow meter circuit<br>• Short — VC, E2 or VS — VC                 | • Open or short in air flow meter circuit<br>• Air flow meter<br>• ECU                                                                                   | ○         |
| 41       | — 00000000                                    | Throttle Position Sensor Signal  | *3 ON                        | Open or short detected in throttle position sensor signal (VTA) for 500 msec. or more                                             | • Open or short in throttle position sensor circuit<br>• Throttle position sensor<br>• ECU                                                               | ○         |
| 42       | — 00000000                                    | Vehicle Speed Sensor Signal      | OFF                          | SPD signal is not input to the ECU for at least 8 seconds during high load driving (engine speed between 2,200 rpm and 5,000 rpm) | • Open or short in vehicle speed sensor circuit<br>• Vehicle speed sensor<br>• ECU                                                                       | ○         |
| 43       | — 00000000                                    | Starter Signal                   | OFF                          | Starter signal (STA) is not input to ECU even once until engine reaches 800 rpm or more when cranking                             | • Open or short in starter signal circuit<br>• Open or short in IG SW or main relay circuit<br>• ECU                                                     | ○         |
| 52       | — 00000000                                    | Knock Sensor Signal              | ON                           | With engine speed 2,000 rpm or more signal from knock sensor is not input to ECU for 25 revolution (KNC)                          | • Open or short in knock sensor circuit<br>• Knock sensor (looseness, etc.)<br>• ECU                                                                     | ○         |
| 53       | — 00000000                                    | Knock Control Signal             | ON                           | The engine control computer (for knock control) malfunction is detected                                                           | • ECU                                                                                                                                                    | x         |
| *5 71    | — 00000000                                    | EGR Gas Temp. Sensor Malfunction | DN                           | EGR gas temp. sensor signal (THG) is not input to ECU for 50 seconds in EGR operation range<br>*6 (2 trip detection logic)        | • Open in EGR gas temp. sensor circuit<br>• EGR gas temp. sensor<br>• EGR vacuum hose disconnected, valve stuck<br>• Clogged in EGR gas passage<br>• ECU | ○         |
| S1       | — 00000000                                    | Switch Condition Signal          | OFF                          | Displayed when IDL contact OFF or shift position in "R", "D", "2" or "1" ranges with the check terminals E1 and TE1 connected.    | • Throttle position sensor IDL circuit<br>• Neutral start switch circuit<br>• Accelerator pedal cable<br>• ECU                                           | x         |

## REMARKS

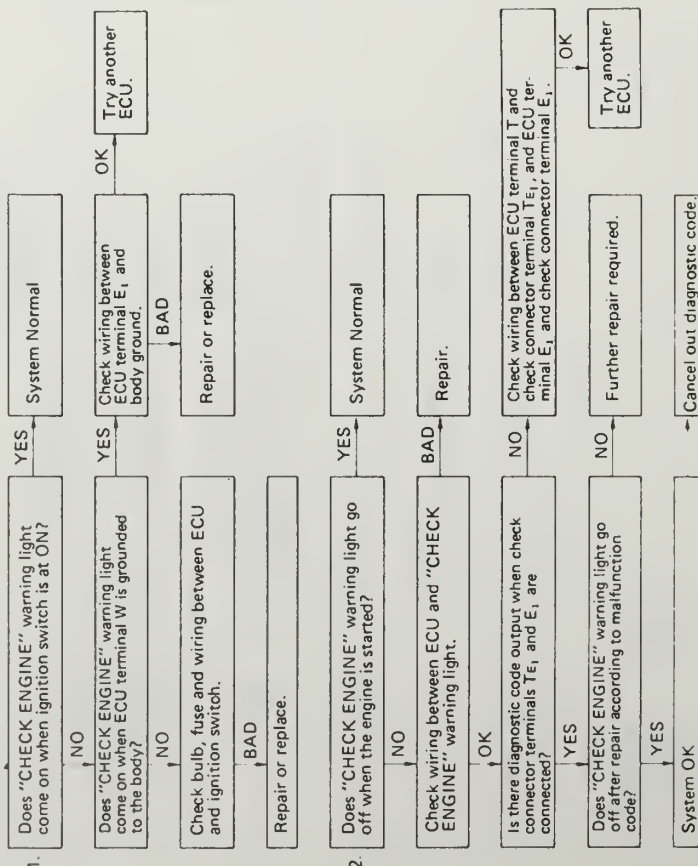
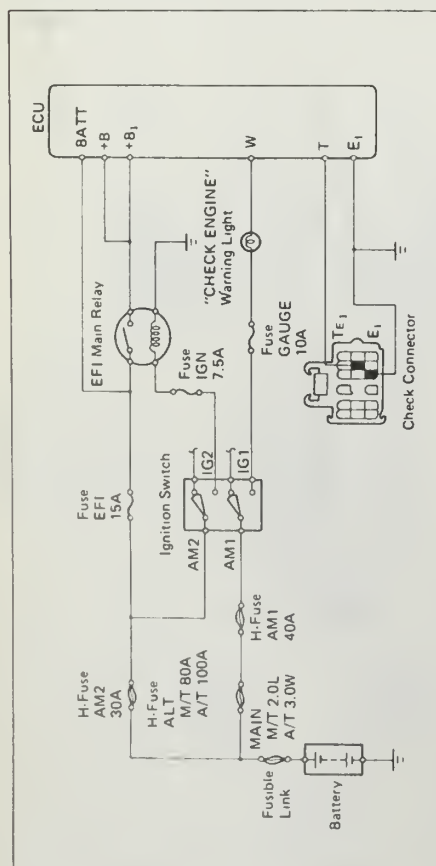
- \*1: "ON" displayed in the diagnosis mode column indicates that the "CHECK ENGINE" Warning Light is lighted up when a malfunction is detected.  
"OFF" indicates that the "CHECK" does not light up during malfunction diagnosis, even if a malfunction is detected.
- \*2: "○" in the memory column indicates that a diagnostic code is recorded in the ECU memory when a malfunction occurs. "x" indicates that a diagnostic code is not recorded in the ECU memory even if a malfunction occurs. Accordingly, output of diagnostic results is performed with the IG SW/ ON.
- \*3: The "CHECK ENGINE" Warning Light comes on if malfunction occurs only for California specification vehicles.
- \*4: No. (2) in the diagnostic contents of codes No.25 and 26 applies to California specification vehicles only, while (1) applies to all models.
- \*5: Codes 27 and 71 are used only for California specifications vehicles.
- \*6: "2 trip detection logic"

| Code No. | Number of blinks "CHECK ENGINE" Warning Light | System                            | "CHECK ENGINE" Warning Light | Diagnosis                                                                                                                                                                                                                                                                                                                                                                                                                       | Trouble Area                                                                                                                                                                                                                                                                                                                  | *2 Memory |
|----------|-----------------------------------------------|-----------------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| —        | — 00000000                                    | Normal                            | —                            | Output when no other code is recorded.                                                                                                                                                                                                                                                                                                                                                                                          | —                                                                                                                                                                                                                                                                                                                             | —         |
| 12       | — 00000000                                    | RPM Signal                        | ON                           | No NE signal is input to the ECU for 2 secs. or more after STA turns ON.                                                                                                                                                                                                                                                                                                                                                        | • Open or short in NE circuit<br>• Distributor<br>• Ignition coil<br>• ECU                                                                                                                                                                                                                                                    | ○         |
| 13       | — 00000000                                    | RPM Signal                        | ON                           | NE signal is not input to ECU for 300 msec. or more when engine speed is 1,500 rpm or more.                                                                                                                                                                                                                                                                                                                                     | • Open or short in NE circuit<br>• Distributor<br>• Ignition coil<br>• ECU                                                                                                                                                                                                                                                    | ○         |
| 14       | — 00000000                                    | Ignition Signal                   | ON                           | IGF signal from igniter is not input to ECU for 4 consecutive ignition.                                                                                                                                                                                                                                                                                                                                                         | • Open or short in IGF or IGT circuit from igniter to ECU<br>• Igniter<br>• ECU                                                                                                                                                                                                                                               | ○         |
| 21       | — 00000000                                    | Main Oxygen Sensor Signal         | ON                           | (1) Open or short in heater circuit of main oxygen sensor (MFI)<br>(2) Main oxygen sensor heater engine speed is above 1,700 rpm, amplitude of main oxygen sensor signal (IOX1) is reduced to between 0.35—0.70 V continuously for 60 secs. or more.<br>*6 (2 trip detection logic) (2)                                                                                                                                         | • Open or short in heater circuit of main oxygen sensor<br>• Main oxygen sensor heater<br>• ECU                                                                                                                                                                                                                               | ○         |
| 22       | — 00000000                                    | Water Temp. Sensor Signal         | ON                           | Open or short in water temp. sensor circuit for 500 msec. or more (THW)                                                                                                                                                                                                                                                                                                                                                         | • Open or short in water temp. sensor circuit<br>• Water temp. sensor<br>• ECU                                                                                                                                                                                                                                                | ○         |
| 24       | — 00000000                                    | Intake Air Temp. Sensor Signal    | *3 ON                        | Open or short in intake air temp. sensor circuit for 500 msec. or more. (THA)                                                                                                                                                                                                                                                                                                                                                   | • Open or short in intake air temp. circuit<br>• Intake air temp. sensor<br>• ECU                                                                                                                                                                                                                                             | ○         |
| 25       | — 00000000                                    | Air-Fuel Ratio Sensor Malfunction | ON                           | (1) Oxygen sensor output in less than 0.45 V for at least 90 secs. when oxygen sensor is warmed up (aging at 2,000 rpm). —Only for code 25<br>*4<br>(2) When air fuel ratio feedback correction value or adaptive control value continues at the upper (lean) or lower (rich) limit for a certain period of time or more, the feedback value is renewed for a certain period of time<br>*6 (2 trip detection logic) (1) and (2) | • Engine ground bolt loose<br>• Open in E1 circuit<br>• Fuel line pressure (injector blockage, etc.)<br>• Open or short in oxygen sensor circuit<br>• Oxygen sensor<br>• Fuel line pressure (injector blockage, etc.)<br>• Water temp. sensor<br>• Air flow meter (Air intake)<br>• ECU                                       | ○         |
| 26       | — 00000000                                    | Air-Fuel Ratio Sensor Malfunction | ON                           |                                                                                                                                                                                                                                                                                                                                                                                                                                 | • Engine ground bolt loose<br>• Open in E1 circuit<br>• Fuel line pressure (injector blockage, etc.)<br>• Open or short in cold start injector circuit<br>• Cold start injector<br>• Oxygen sensor in oxygen sensor circuit<br>• Oxygen sensor<br>• Water temp. sensor<br>• Air flow meter<br>• Compression pressure<br>• ECU | ○         |



## TESTING THE ECU DIAGNOSTIC CIRCUIT – 1991 4RUNNER WITH 22R-E

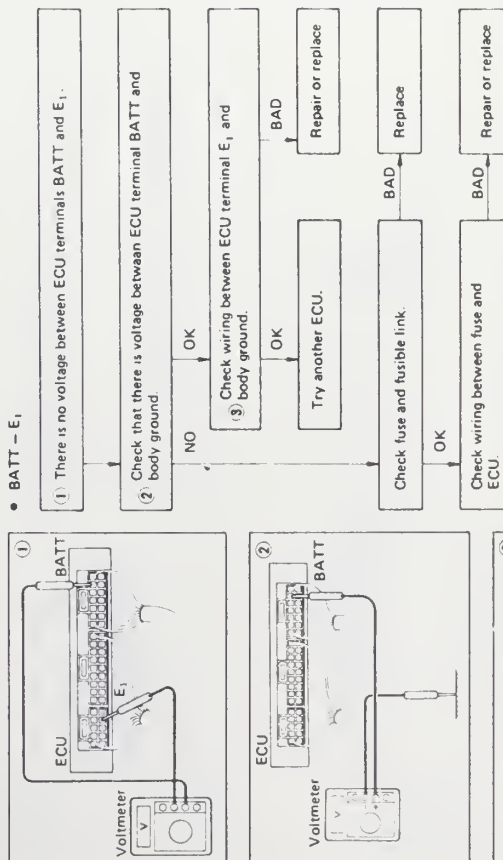
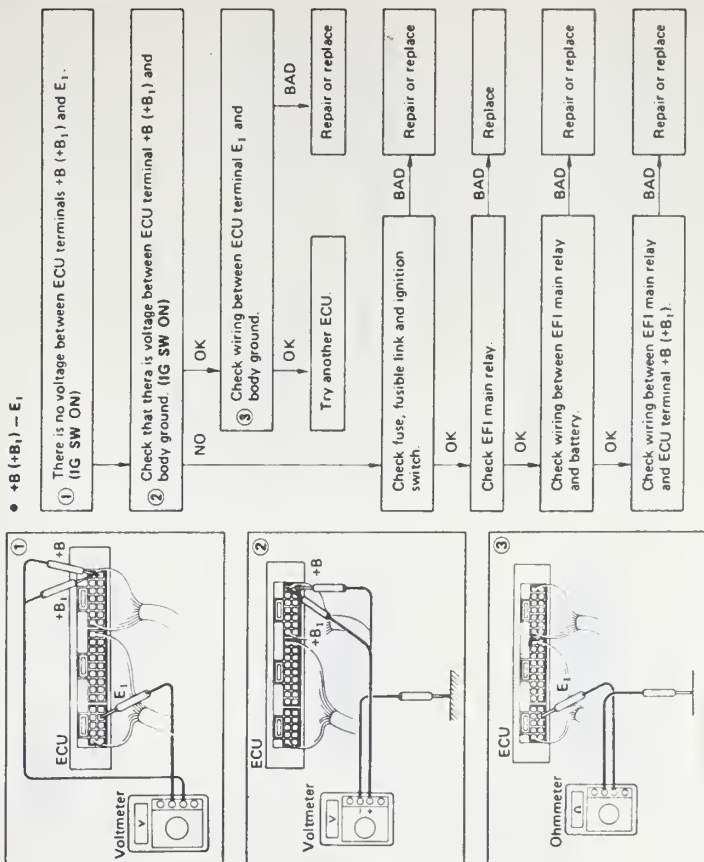
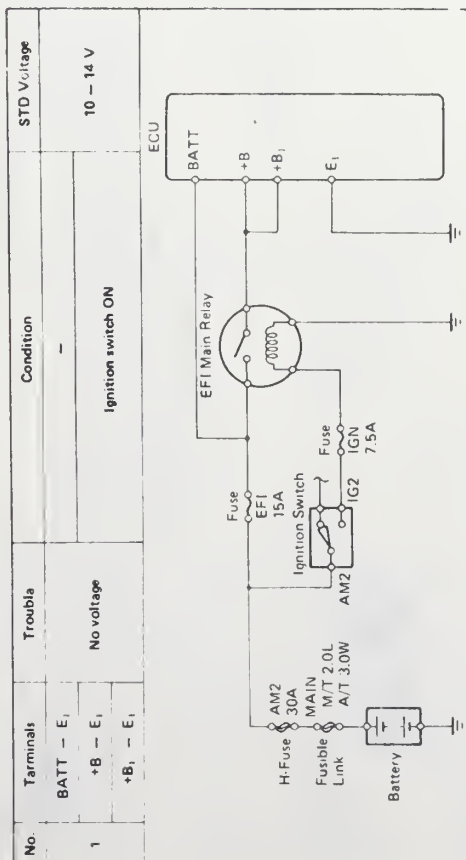
## ECU TERMINALS – 1991 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS

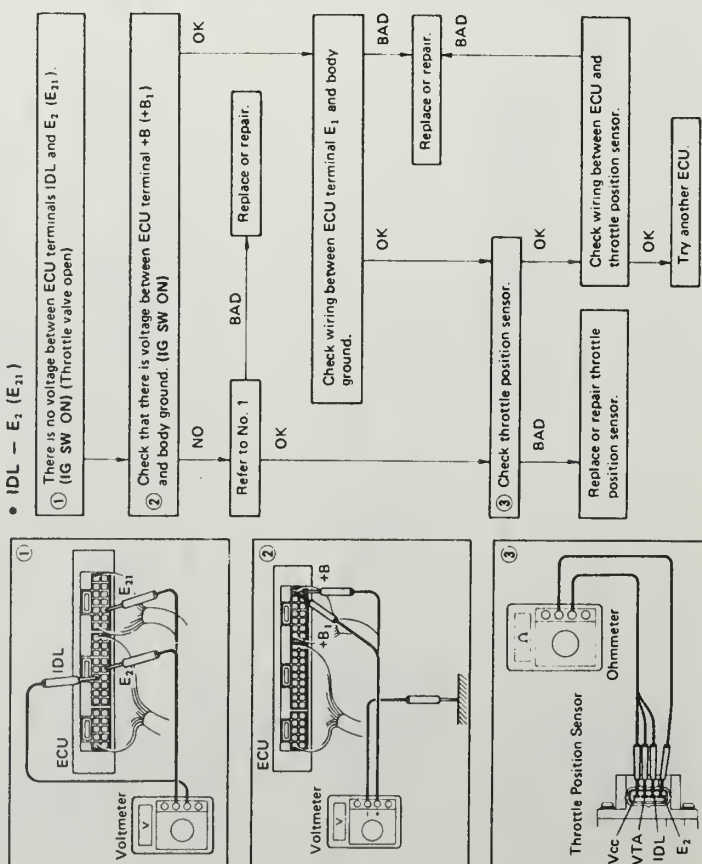
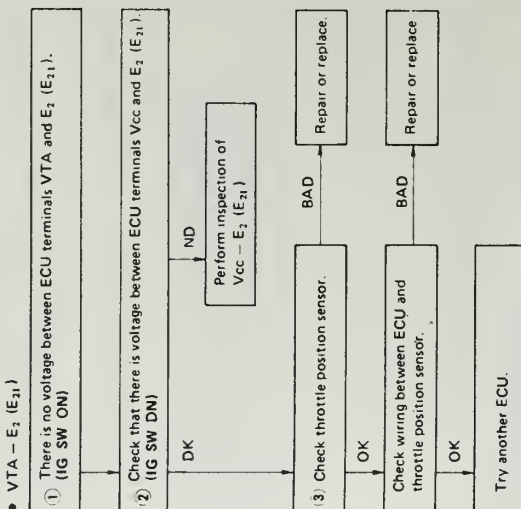
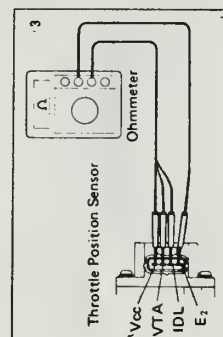
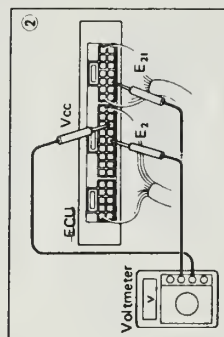
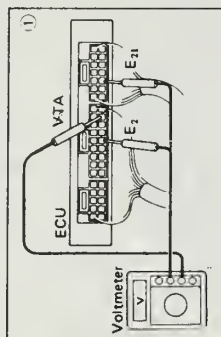
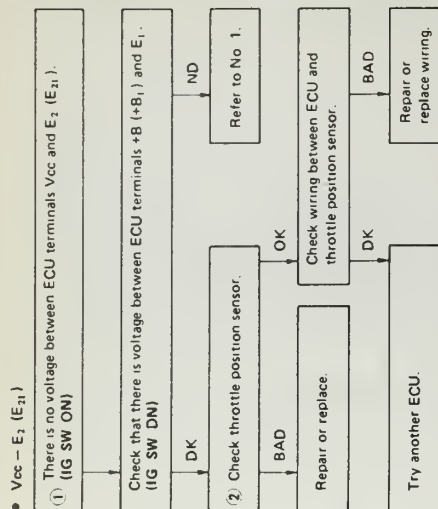
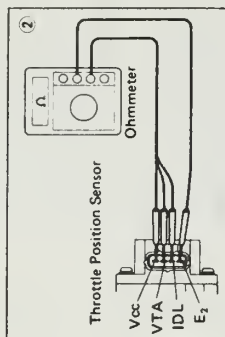
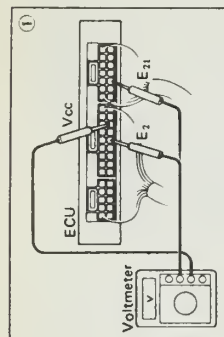
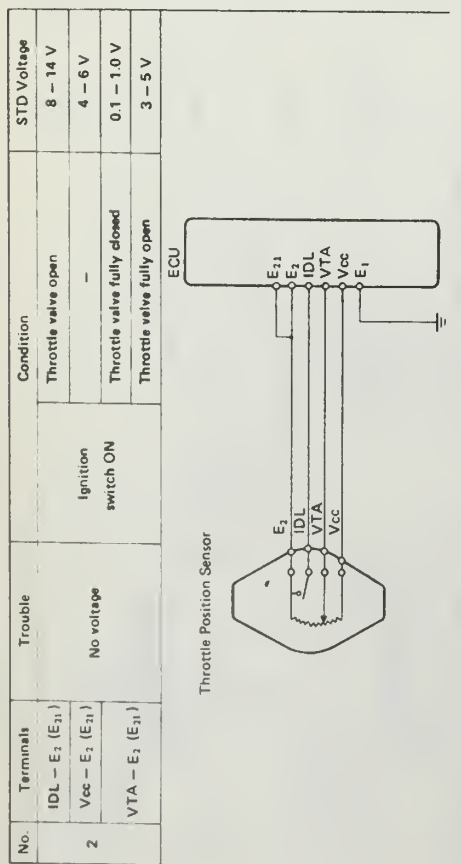


| Symbol | Terminal Name              | Symbol | Terminal Name            |
|--------|----------------------------|--------|--------------------------|
| E01    | ENGINE GROUND              | Ox1    | OXYGEN SENSOR            |
| E02    | ENGINE GROUND              | *1 THG | EGR GAS TEMP. SENSOR     |
| No. 10 | INJECTOR                   | Vcc    | THROTTLE POSITION SENSOR |
| No. 20 | INJECTOR                   | KNK    | KNOCK SENSOR             |
| STA    | STARTER SWITCH             | VTA    | THROTTLE POSITION SENSOR |
| IGt    | IGNITER                    | Ne     | DISTRIBUTOR              |
| STJ    | COLD START INJECTOR        | THW    | WATER TEMP. SENSOR       |
| E1     | ENGINE GROUND              | *2 ECT | OD RELAY                 |
| *2 NSW | NEUTRAL START SWITCH       | Vc     | AIR FLOW METER           |
| V-     | CHECK CONNECTOR            | E21    | SENSOR GROUND            |
| Fdu    | FUEL PRESSURE UP VSV       | Vs     | AIR FLOW METER           |
| W      | CHECK ENGINE WARNING LIGHT | *3 4WD | 4WD SWITCH               |
| AS     | AS VSV                     | THA    | AIR TEMP. SENSOR         |
| T      | CHECK CONNECTOR            | SPD    | SPEED SENSOR             |
| IDL    | THROTTLE POSITION SENSOR   | BATT   | BATTERY +B               |
| HT1    | OXYGEN SENSOR HEATER       | STP    | STOP LIGHT SWITCH        |
| IGf    | IGNITER                    | +B1    | MAIN RELAY               |
| E2     | SENSOR GROUND              | +B     | MAIN RELAY               |

\*1: California only \*2: A/T only \*3: 4WD only

|               |     |     |     |    |     |     |     |     |     |     |     |     |    |    |    |     |      |     |
|---------------|-----|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|-----|------|-----|
| E01 No 10 STA | STJ | NSW | Fdu | W  | T   | IDL | IGf | HT1 | E2  | Ox1 | THG | KNK | Ne | Vc | V1 | THA | BATT | +B1 |
| E02 No 20     | IGt | E1  | Vf  | AS | THW | VTA | Vcc | E21 | 4WD | SPD | STP | +B  |    |    |    |     |      |     |



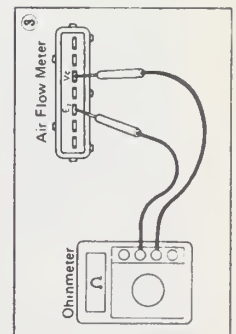
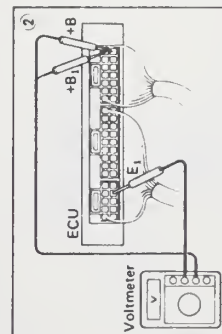
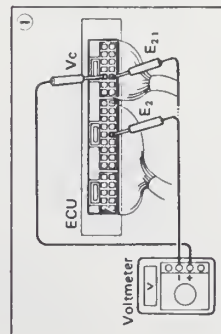
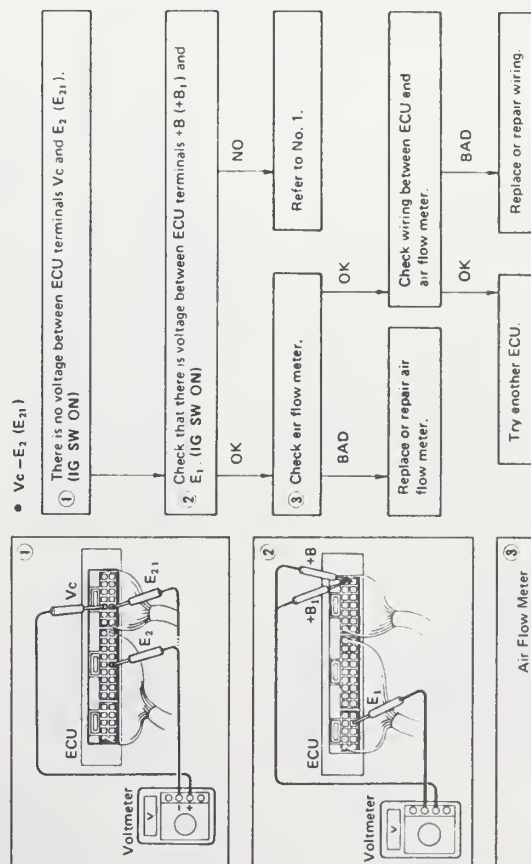
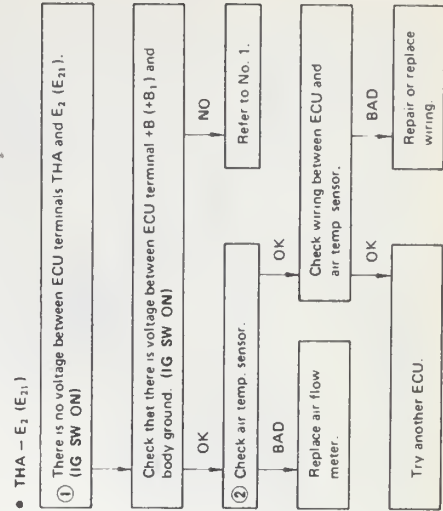
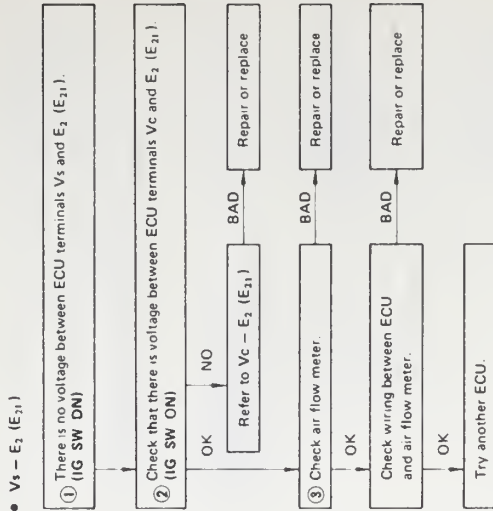
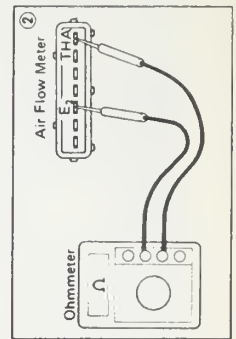
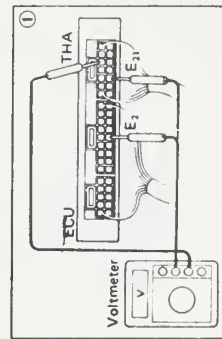
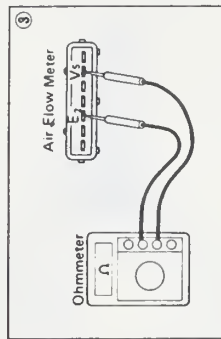
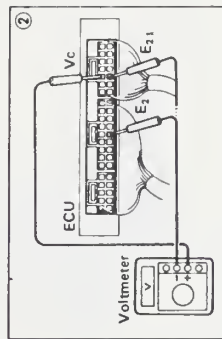
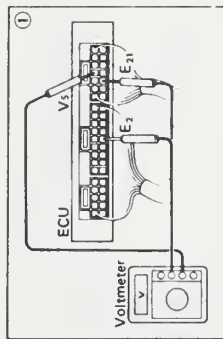




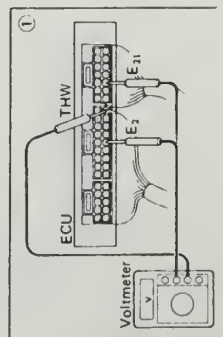
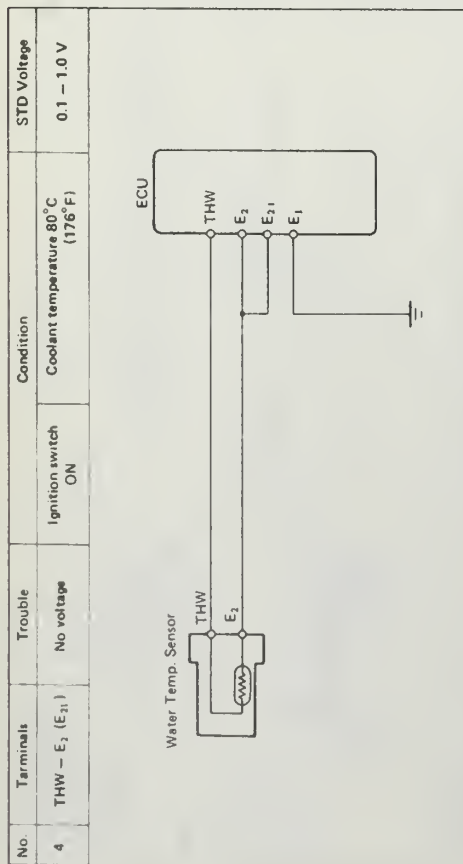
| No | Terminals                | Trouble    | Condition                          | STD Voltage |
|----|--------------------------|------------|------------------------------------|-------------|
| 3  | $V_c - E_3$ ( $E_{31}$ ) | No voltage | Ignition switch ON                 | 6 - 10 V    |
|    | $V_s - E_3$ ( $E_{31}$ ) |            | Measuring plate fully closed       | 0.5 - 2.5 V |
|    |                          |            | Measuring plate fully open         | 5 - 10 V    |
|    | $THA - E_3$ ( $E_{31}$ ) |            | Idling                             | 2 - 8 V     |
|    |                          |            | Intake air temperature 20°C (68°F) | 1 - 3 V     |

The diagram illustrates the electrical connections for testing the ECU. On the left, the 'Air Flow Meter' is shown with terminals THA, VB, VC, VS, E2, and E31. On the right, the 'ECU' is shown with terminals +B, +B1, THA, Vc, Vs, E2, E31, and E1. Wires connect the corresponding terminals between the two components. Specifically, THA connects to THA, VB to Vc, VC to Vc, VS to Vs, E2 to E2, E31 to E31, and E1 to E1. The +B and +B1 terminals on the ECU are connected to a common power source, indicated by a ground symbol.



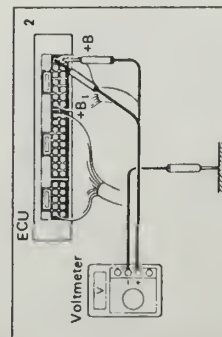
# ECU TEST NO.4 – 1991 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS



① There is no voltage between ECU terminals THW and E<sub>2</sub> (E<sub>31</sub>).

② Check that there is voltage between ECU terminal +B (+B<sub>1</sub>) and body ground. (IG SW ON)

OK  
NO  
Refer to No. 1.



Check wiring between ECU terminal E<sub>1</sub> and body ground.

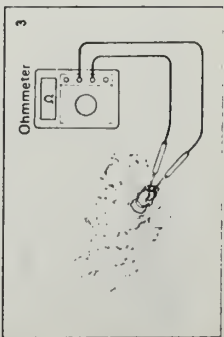
OK  
BAD  
Repair or replace.

③ Check water temp. sensor.

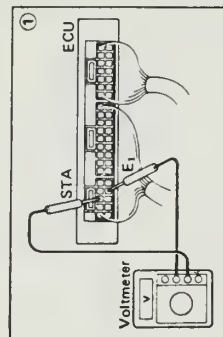
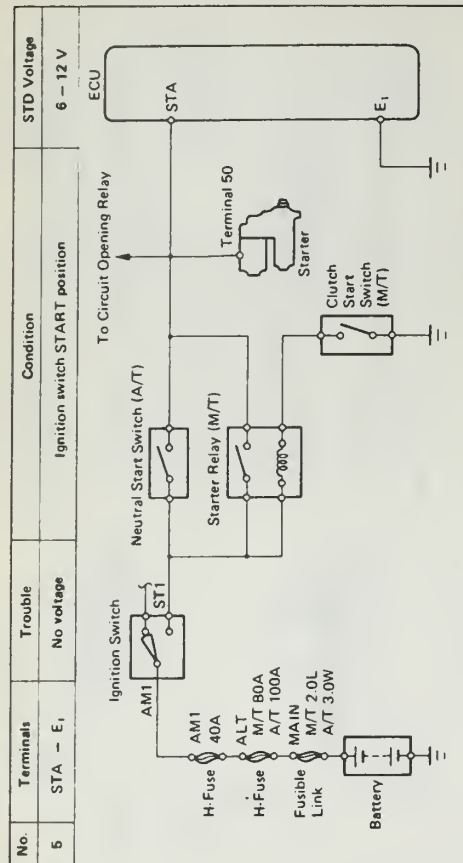
OK  
BAD  
Replace water temp. sensor.

Check wiring between ECU and water temp. sensor.

OK  
BAD  
Try another ECU.



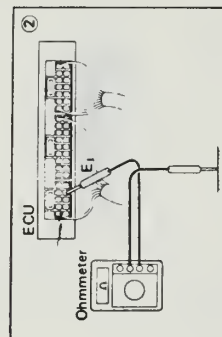
# ECU TEST NO.5 – 1991 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS



① There is no voltage between ECU terminals STA and E<sub>1</sub>.

Check starter operation.

OK  
BAD  
Repair or replace.



② Check wiring between ECU terminal E<sub>1</sub> and body ground.

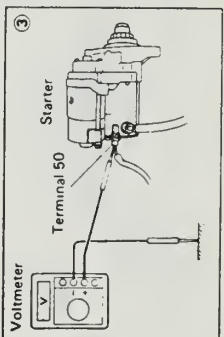
OK  
BAD  
Try another ECU.

Check fusible link, battery, wiring and ignition switch.

OK  
BAD  
Repair or replace.

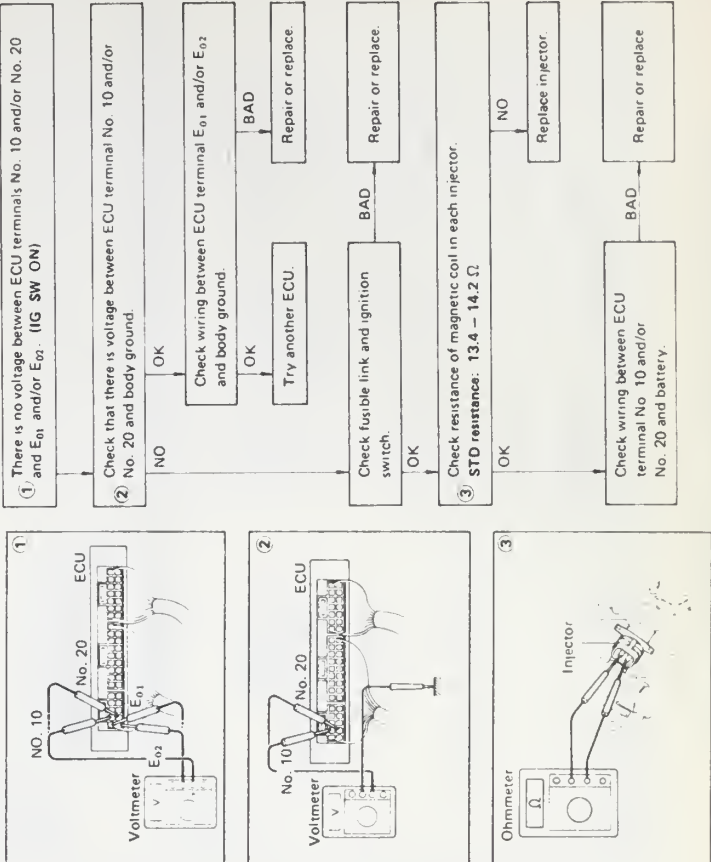
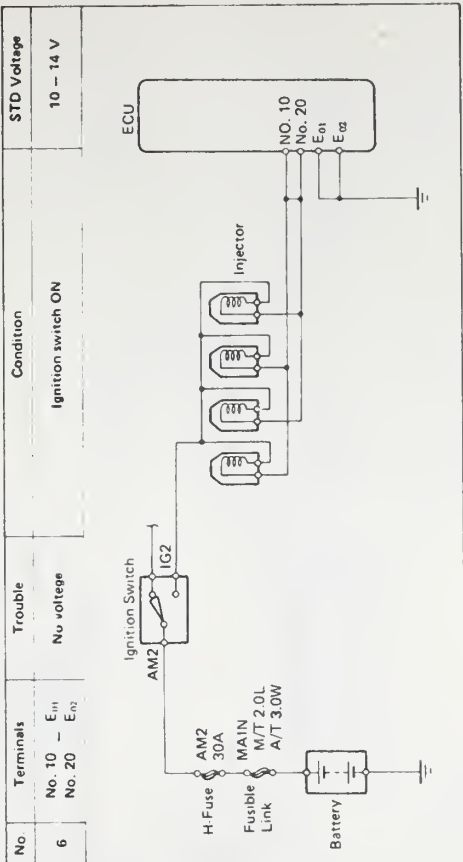
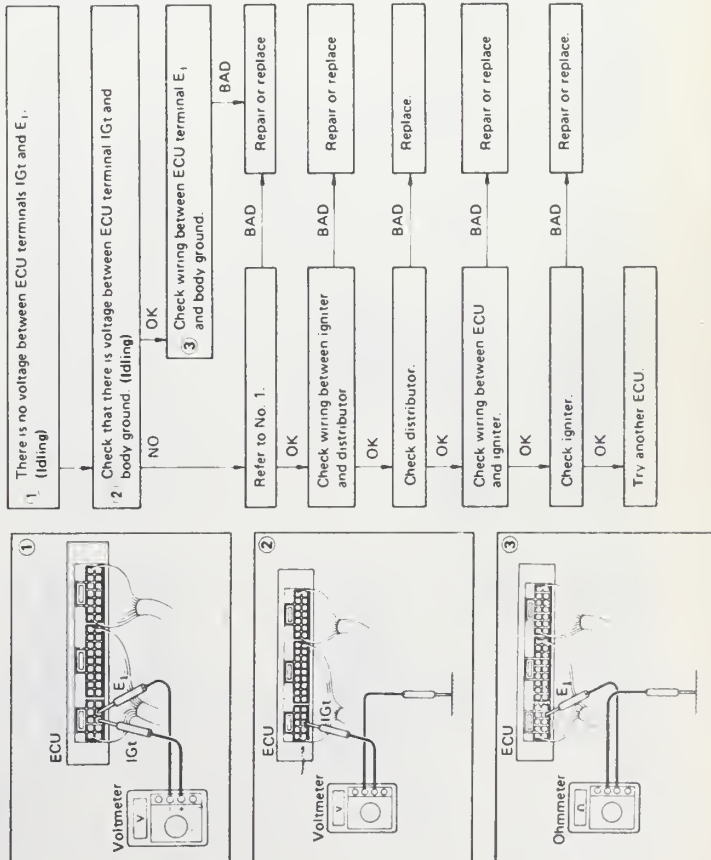
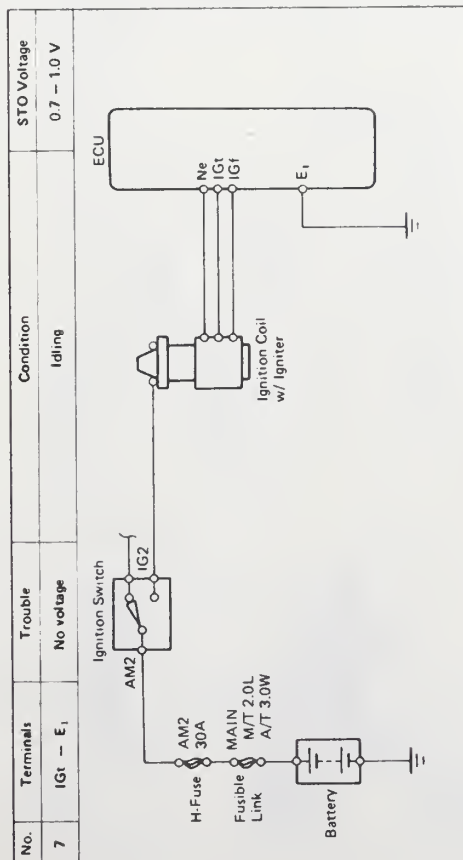
③ Check that there is voltage at terminal 50 of starter.

OK  
NO  
Check wiring between ignition switch ST<sub>1</sub> terminal and starter terminal 50.



# ECU TEST NO.6 — 1991 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS

# ECU TEST NO.7 — 1991 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS



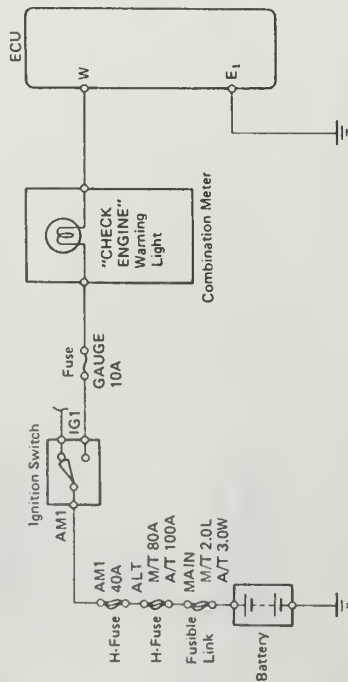


**ECU TEST NO.8 – 1991 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS**

| No. | Terminals          | Trouble    | Condition                                                        | STD Voltage |
|-----|--------------------|------------|------------------------------------------------------------------|-------------|
| 8   | W - E <sub>1</sub> | No voltage | No trouble ("CHECK ENGINE" warning light off) and engine running | 10 - 14 V   |

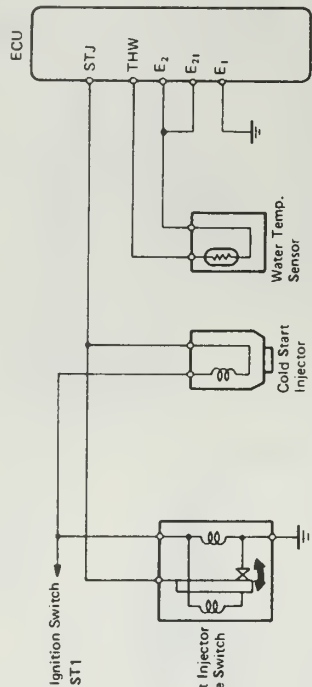
  

The diagram illustrates the electrical circuit for the "CHECK ENGINE" warning light. Power originates from the battery and flows through a fusible link. It then branches into two paths: one leading to terminal AM1 via a 40A fuse, and another leading to terminal A/T via a series of fuses (80A, 100A, and main). Both paths converge at the ignition switch (IG1). The ignition switch controls the "CHECK ENGINE" warning light and a 10A gauge. The circuit is completed by connecting the other side of the light/gauge to the ECU (W) and then to terminal E1, which is grounded.



| No. | Terminal             | Trouble    | Condition                        | STD Voltage |
|-----|----------------------|------------|----------------------------------|-------------|
| 9   | STJ — E <sub>1</sub> | No voltage | Coolant temperature 80°C (176°F) | 6 — 12 V    |

The diagram illustrates the electrical circuit for the Ignition Switch ST1. The Ignition Switch ST1 is connected to the Start Injector Time Switch, which contains a solenoid and a relay. The Start Injector Time Switch is connected to the Cold Start Injector. The Ignition Switch ST1 is also connected to the ECU terminal STJ. The ECU terminal THW is connected to the Water Temp. Sensor. The ECU terminals E2, E21, and E1 are connected to ground.



**Flowchart:**

```

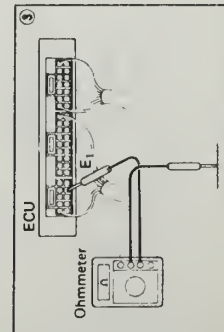
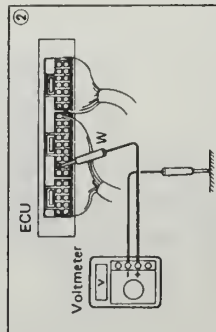
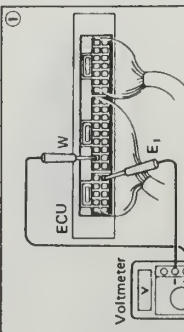
graph TD
 Step1["① There is no voltage between ECU terminals W and E1.
(idling)"] --> Step2["② Check that there is voltage between ECU terminal W and body ground."]
 Step2 -- NO --> Step1
 Step2 -- OK --> Step3["③ Check wiring between ECU terminal E1 and body ground."]
 Step3 -- BAD --> Repair1["Repair or replace."]
 Step3 -- OK --> TryECU["Try another ECU."]
 TryECU --> Step4["Check GAUGE fuse (10A) and 'CHECK ENGINE' warning light."]
 Step4 -- BAD --> Repair2["Repair or replace."]
 Step4 -- OK --> Step5["Check wiring between ECU terminal W and fuse."]
 Repair2 --> Step5
 Step5 -- Fuse blows again --> Repair2
 Step5 -- BAD --> Repair3["Repair or replace."]
 Step5 -- OK --> End[" "]

```

**Diagram ①:** Shows a voltmeter connected between ECU terminal W and ECU terminal E1. The text indicates there is no voltage between these terminals at idling.

**Diagram ②:** Shows a voltmeter connected between ECU terminal W and the vehicle body ground. This step checks for voltage between terminal W and ground.

**Diagram ③:** Shows a voltmeter connected between ECU terminal E1 and the vehicle body ground. This step checks for voltage between terminal E1 and ground.



```

graph TD
 Start([1 There is no voltage between ECU terminals STJ and E1.
(IG SW START)]) --> Decision1{ }
 Decision1 -- NO --> RepairSTJ[Repair cold start injector.]
 Decision1 -- OK --> Step2[2 Check that there is voltage between ECU terminal +B (+B1) and
body ground. (IG SW ON)]
 Step2 --> Decision2{ }
 Decision2 -- NO --> Refer1[Refer to No. 1.]
 Decision2 -- OK --> Step3[3 Check cold start injector.]
 Step3 --> Decision3{ }
 Decision3 -- BAO --> ReplaceSTJ[Replace cold start injector.]
 Decision3 -- OK --> Step4[Check wiring between ECU and cold
start injector.]
 Step4 --> Decision4{ }
 Decision4 -- BAD --> RepairWiring[Repair or replace
wiring.]
 Decision4 -- OK --> Step5[Check wiring between ECU terminal E1 and body
ground.]
 Step5 --> Decision5{ }
 Decision5 -- BAD --> TryECU[Try another ECU.]
 Decision5 -- OK --> End([])

```

1 There is no voltage between ECU terminals STJ and E<sub>1</sub>.  
(IG SW START)

2 Check that there is voltage between ECU terminal +B (+B<sub>1</sub>) and  
body ground. (IG SW ON)

3 Check cold start injector.

Check wiring between ECU and cold  
start injector.

Check wiring between ECU terminal E<sub>1</sub> and body  
ground.

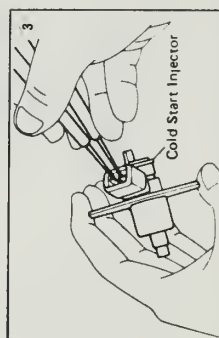
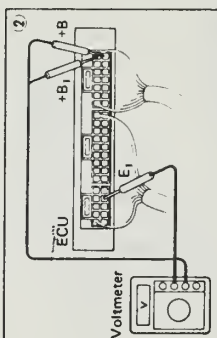
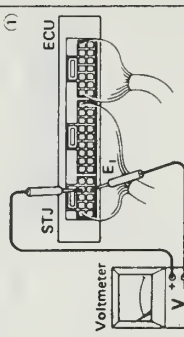
Repair cold start injector.

Refer to No. 1.

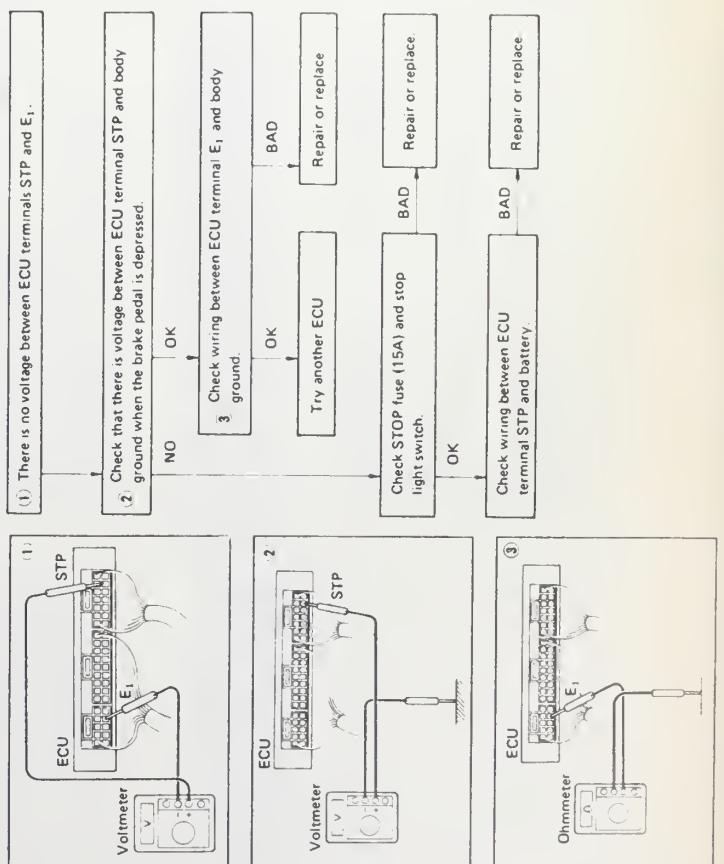
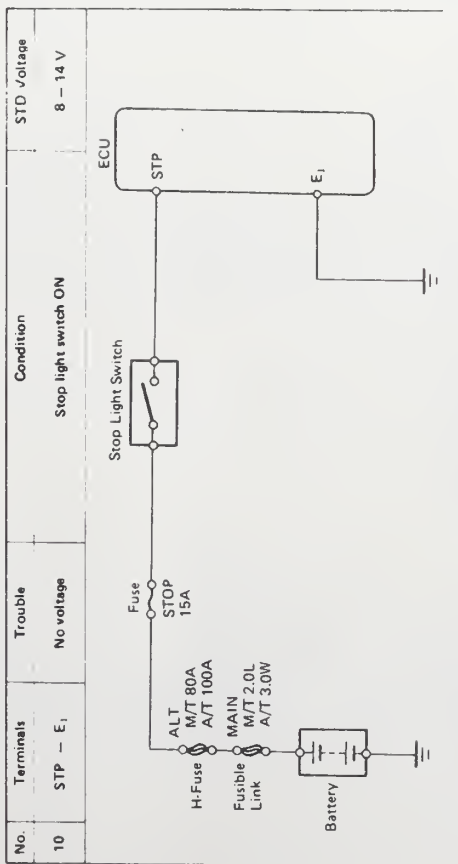
Replace cold start injector.

Repair or replace  
wiring.

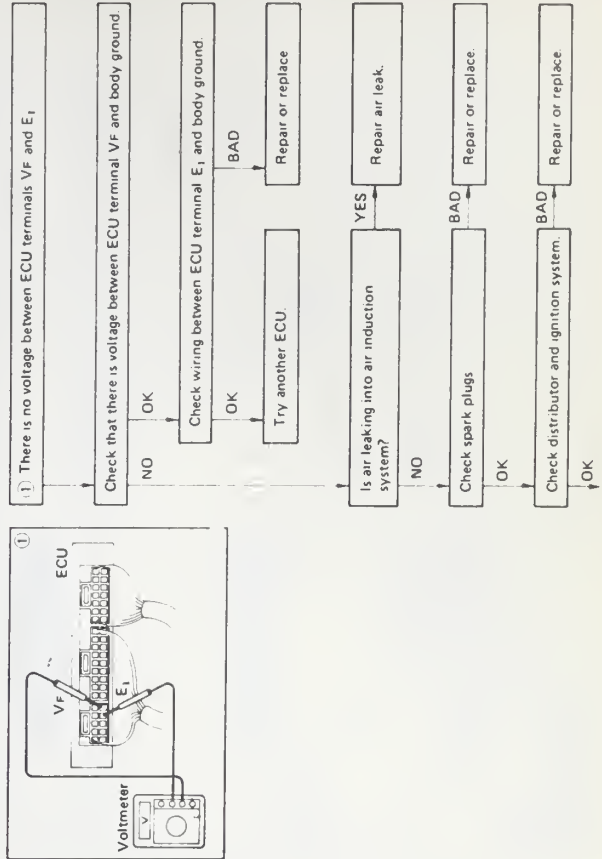
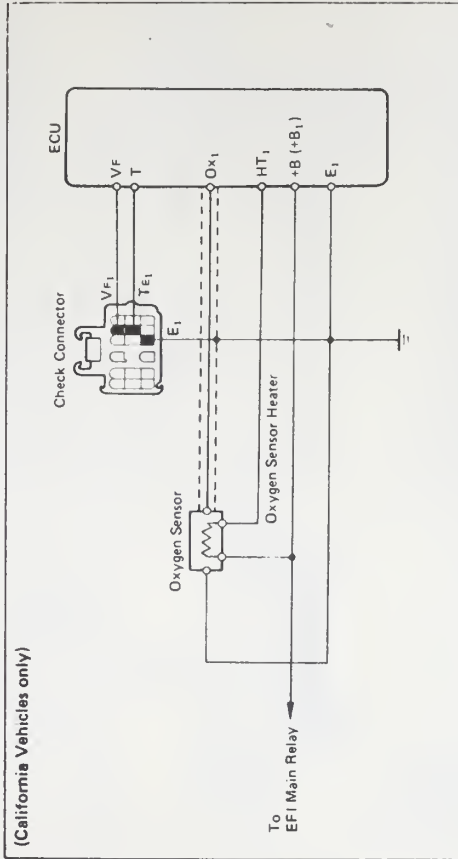
Try another ECU.



# ECU TEST NO.10 – 1991 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS

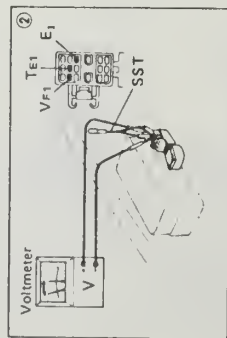
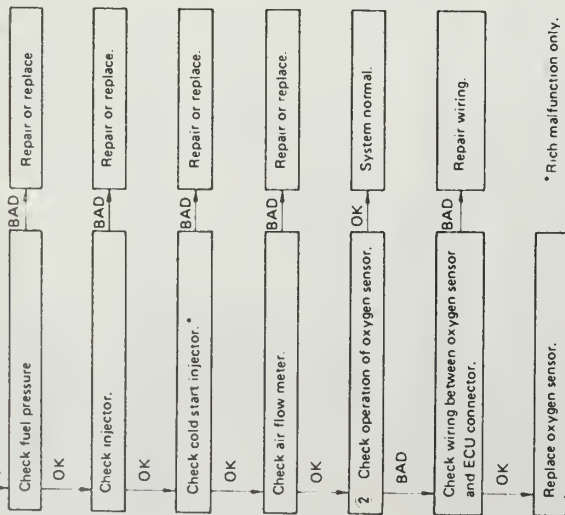


# OXYGEN SENSOR AND HEATER TEST – 1991 CALIFORNIA 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS



# OXYGEN SENSOR AND HEATER TEST (CONTINUED)

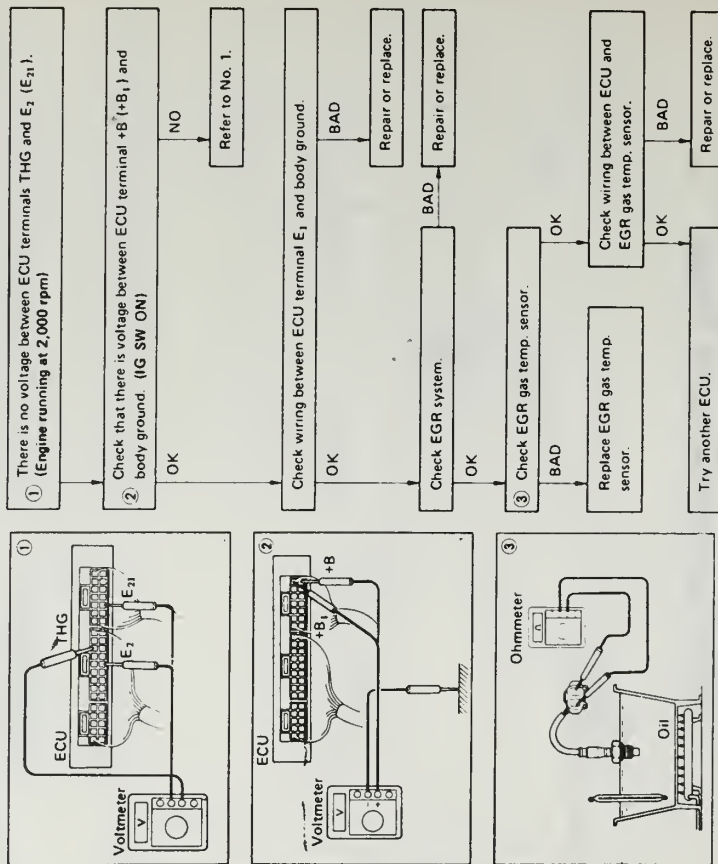
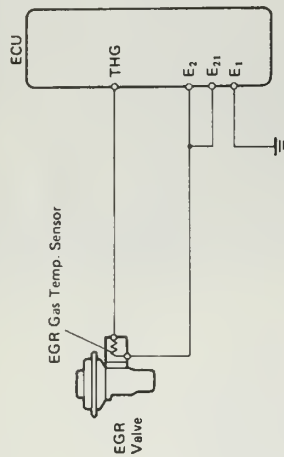
CONTINUED



# 5 FUEL SYSTEM

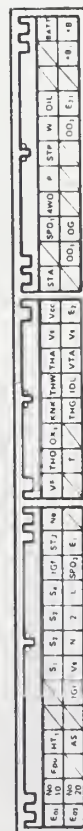
## EGR GAS TEMPERATURE SENSOR TEST – 1991 CALIFORNIA 4RUNNER WITH 22R-E, EXCEPT 4WD WITH AUTO TRANS

(California Vehicles only)



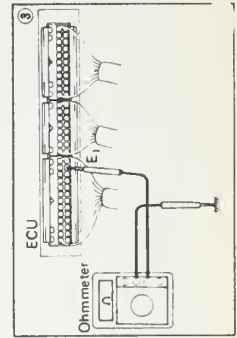


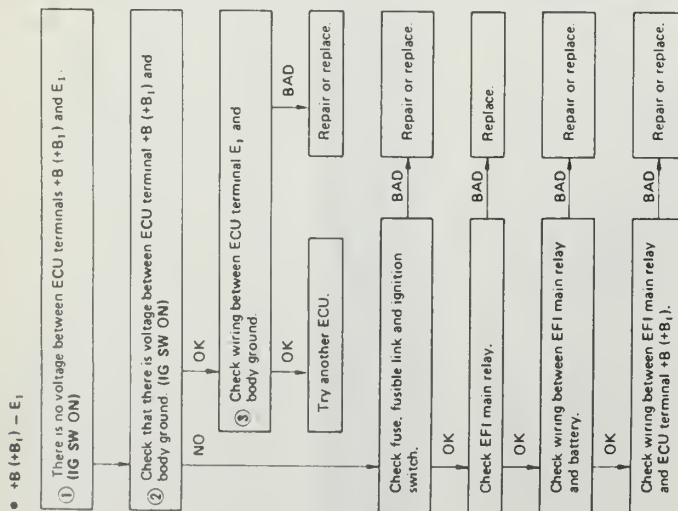
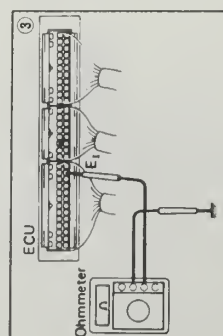
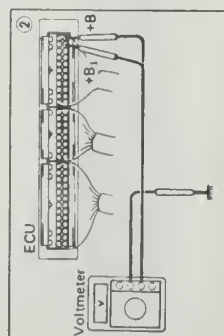
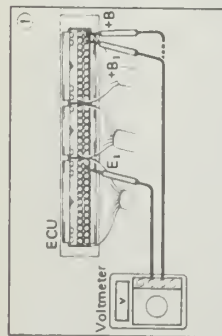
•: California only



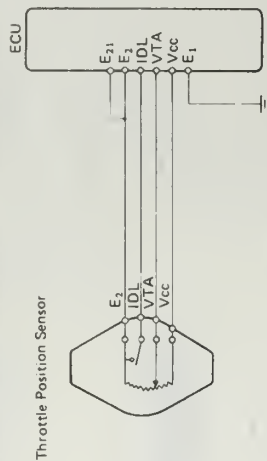
- BATT - E<sub>1</sub>

- ① There is no voltage between ECU terminals BATT and E<sub>1</sub>.
- ② Check that there is voltage between ECU terminal BATT and body ground.

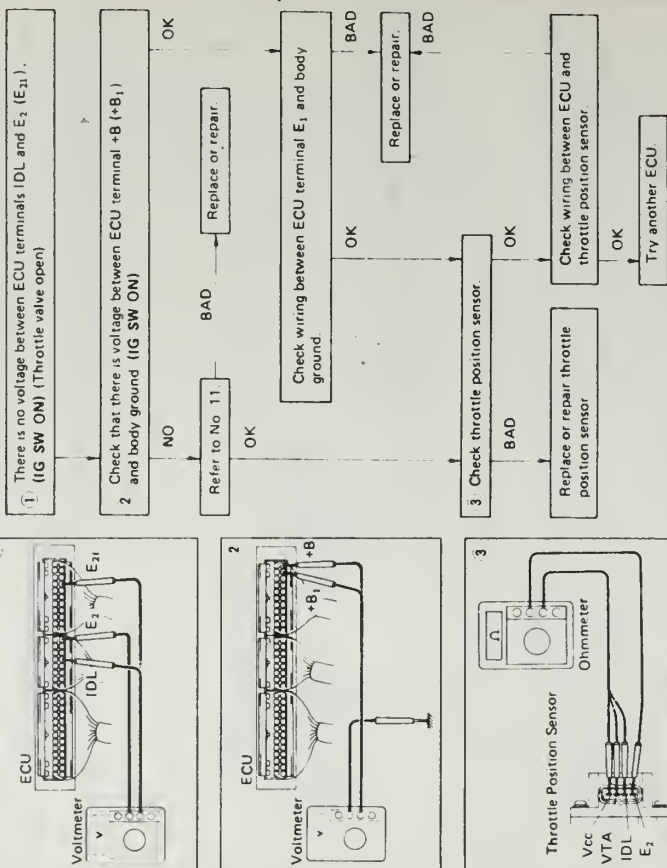


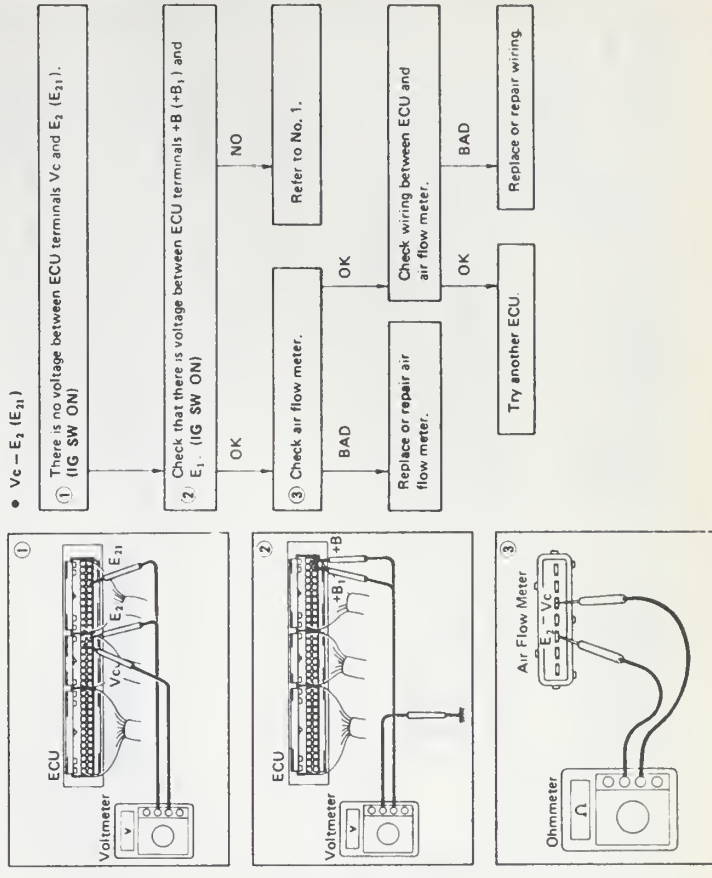
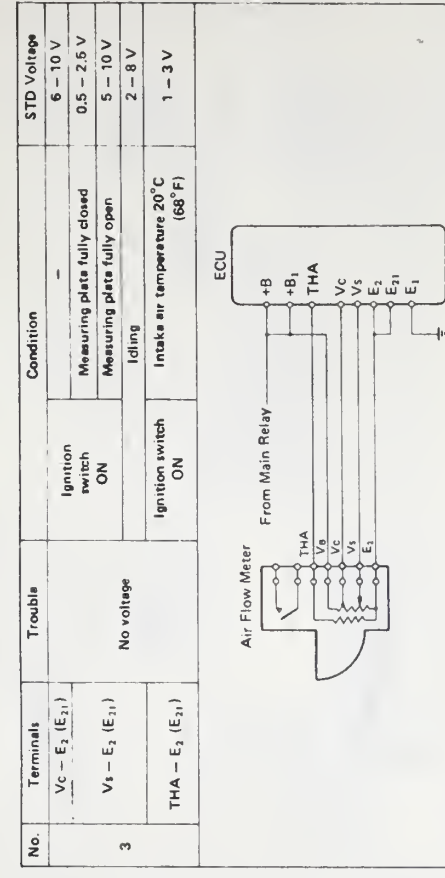
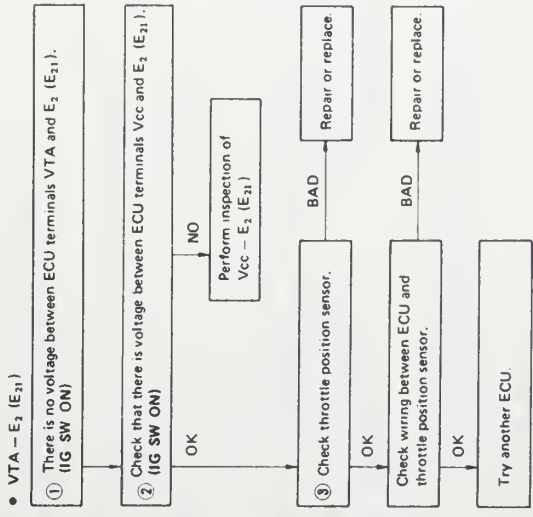
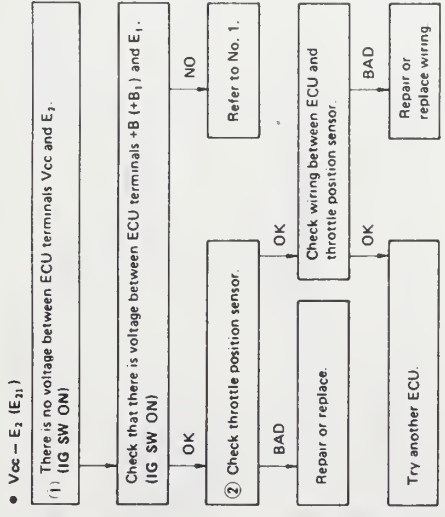
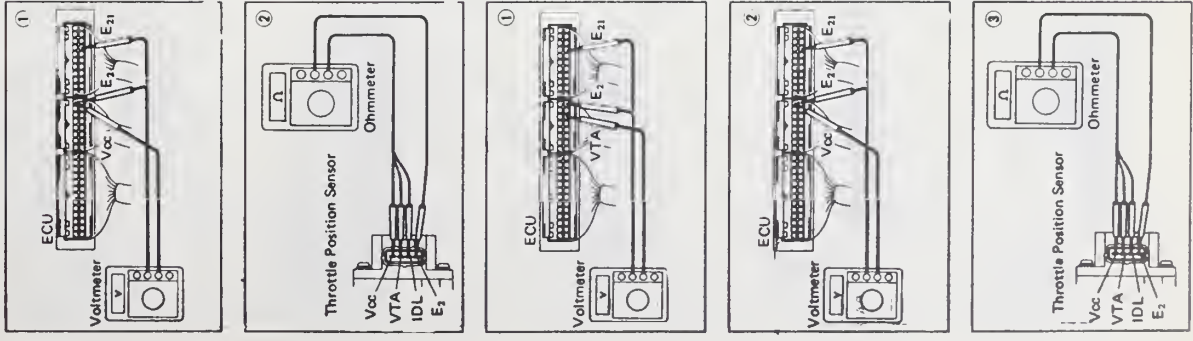


| No. | Terminals                               | Trouble    | Condition                   | STD Voltage |
|-----|-----------------------------------------|------------|-----------------------------|-------------|
| 2   | IDL – E <sub>2</sub> (E <sub>21</sub> ) | No voltage | Throttle valve open         | 8 – 14 V    |
|     | Vcc – E <sub>2</sub> (E <sub>21</sub> ) |            | Ignition switch ON          | 4 – 6 V     |
|     | VTA – E <sub>2</sub> (E <sub>21</sub> ) |            | Throttle valve fully closed | 0.1 – 1.0 V |
|     |                                         |            | Throttle valve fully open   | 3 – 5 V     |

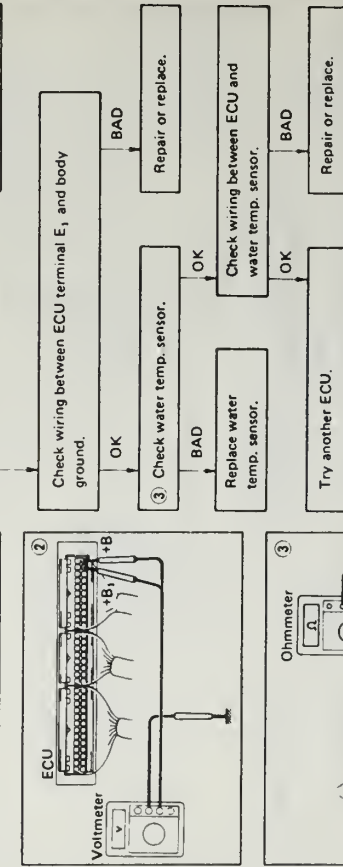
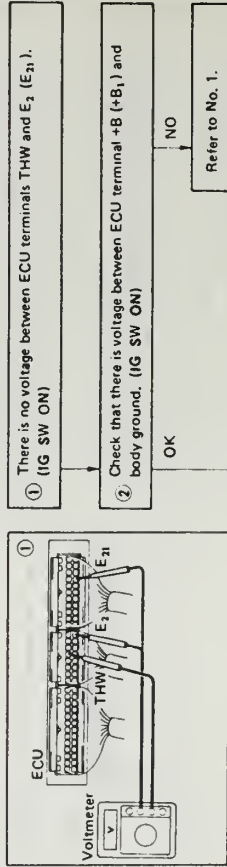
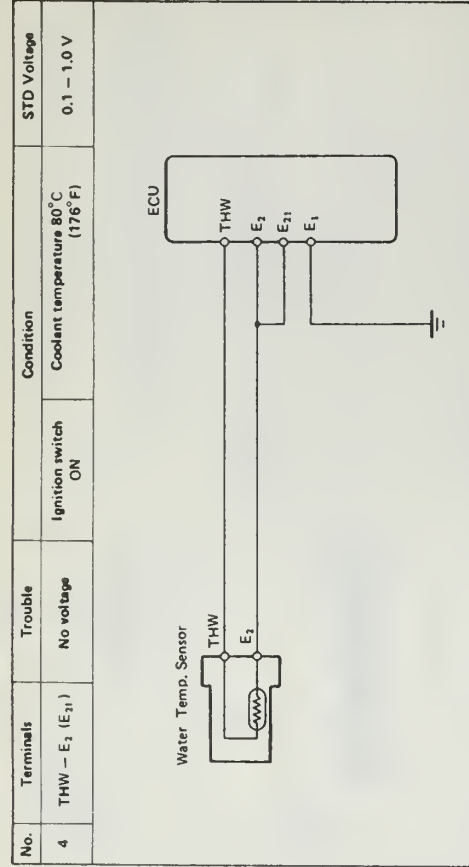
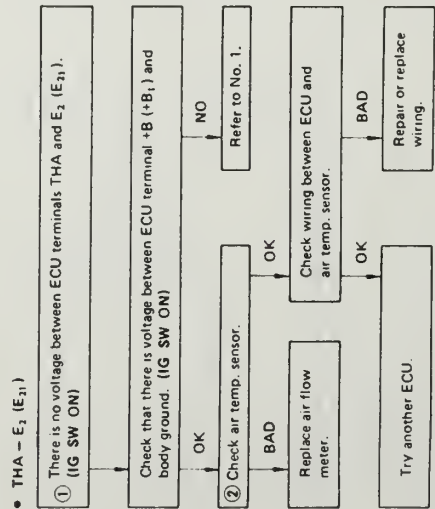
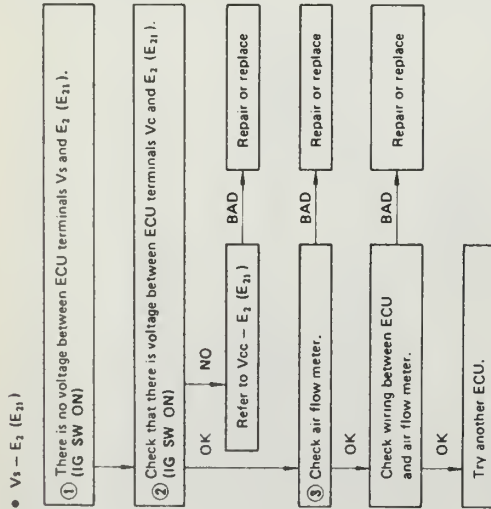
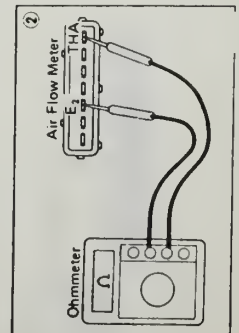
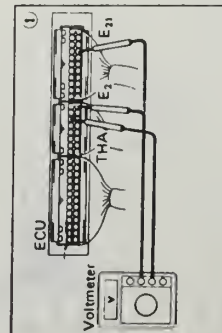
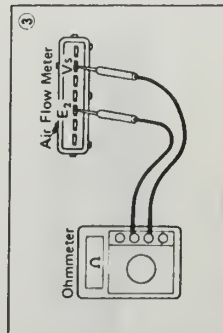
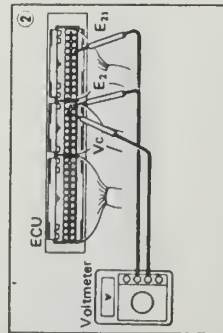
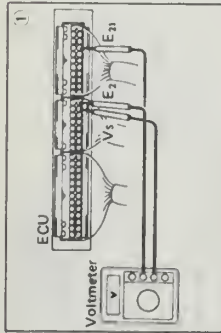


• IDL – E<sub>2</sub> (E<sub>21</sub>)

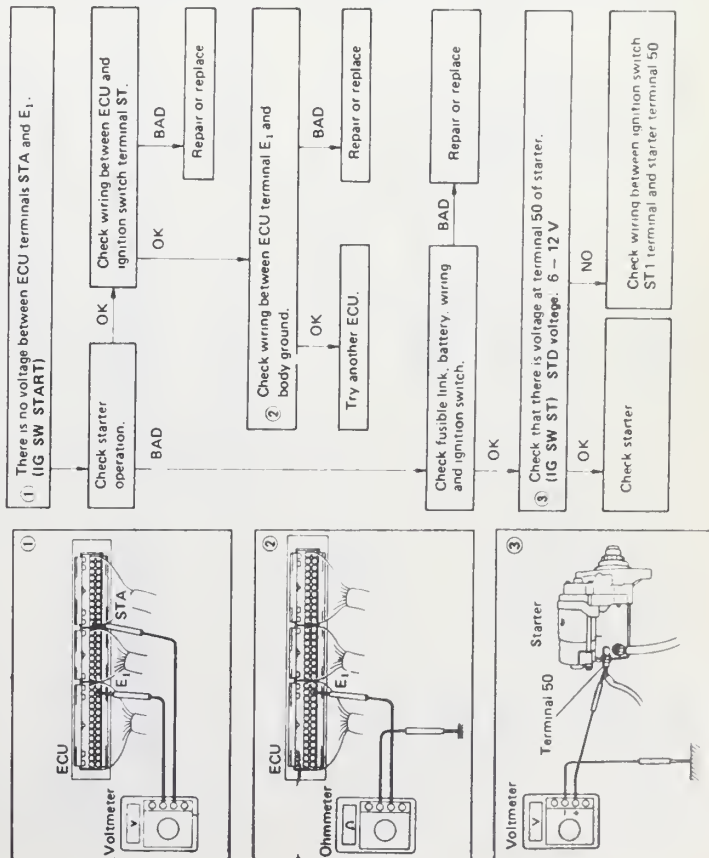
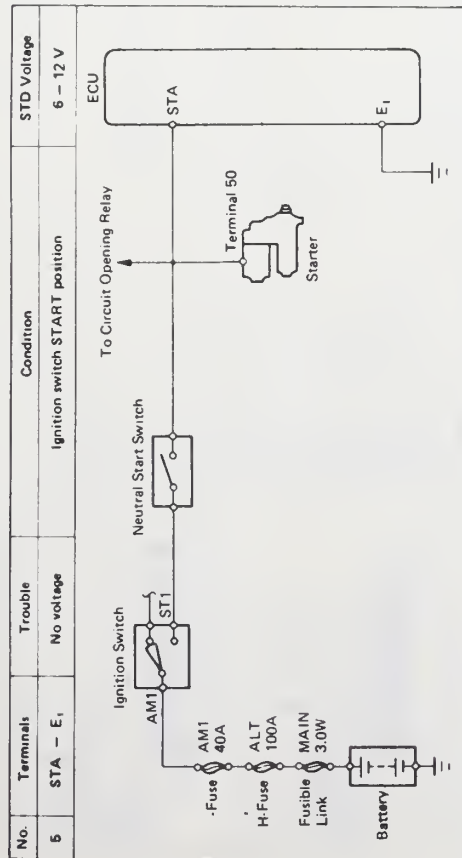




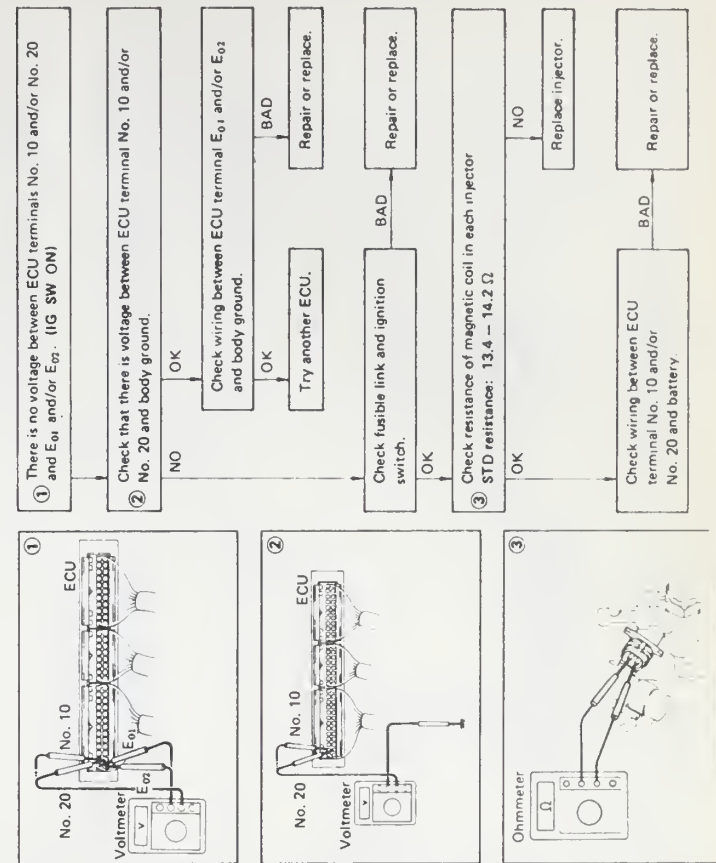
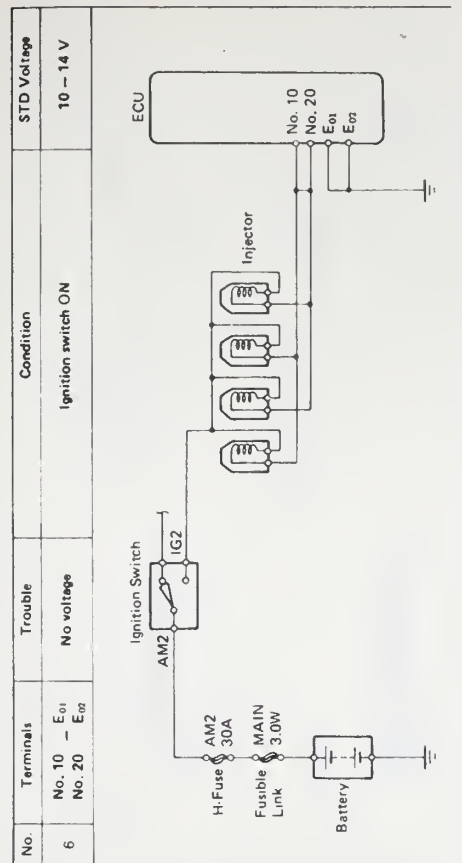




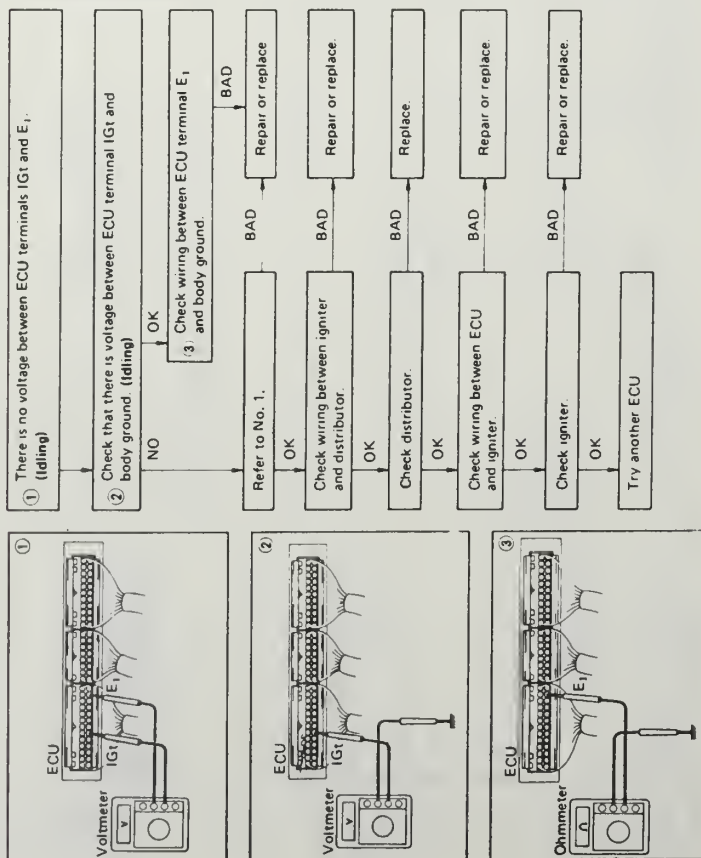
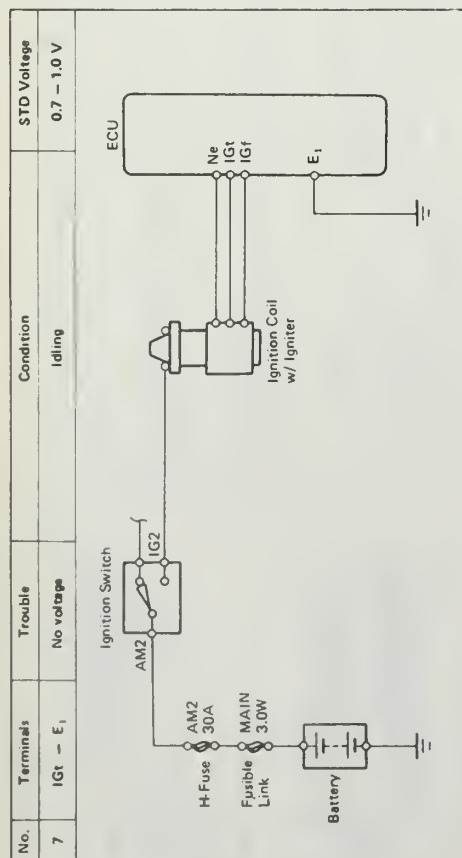
# ECU TEST NO.5 — 1991 4RUNNER WITH 22R-E, 4WD WITH AUTO TRANS



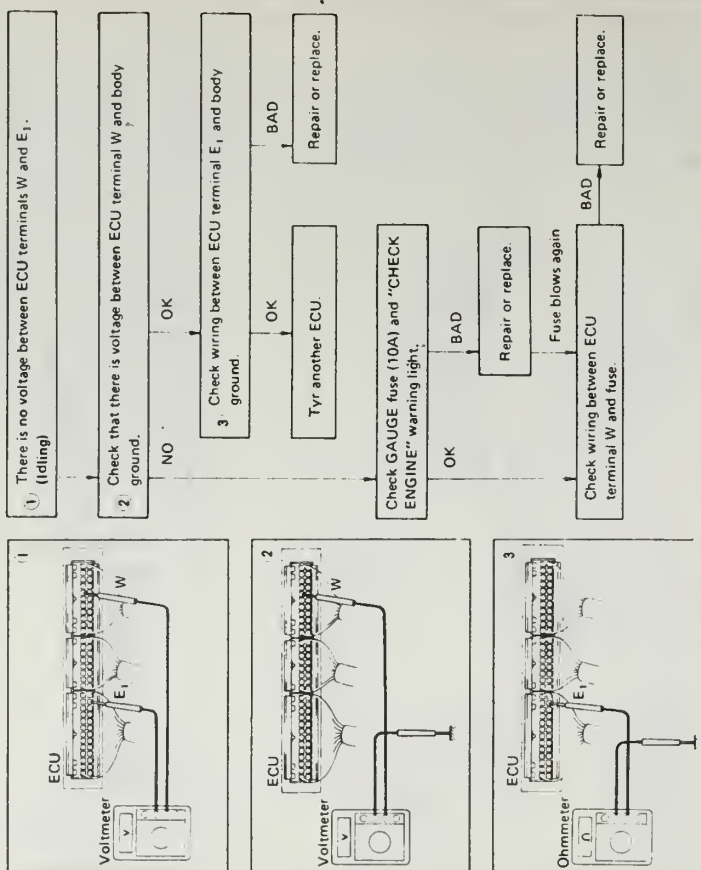
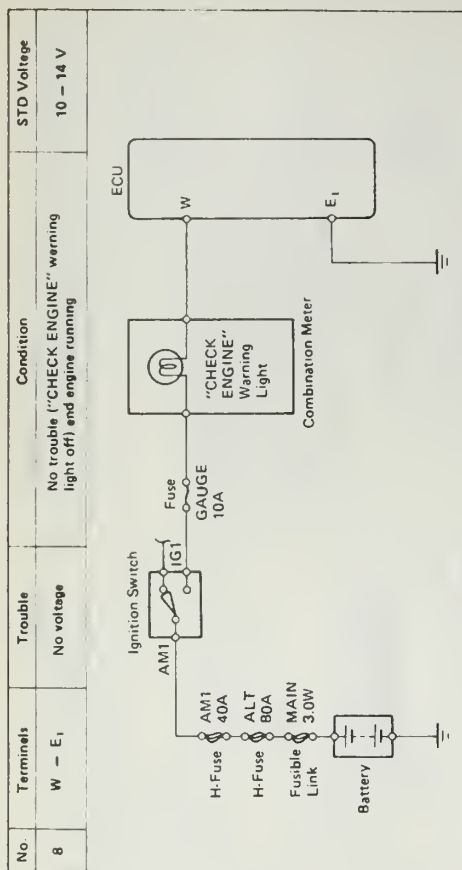
# ECU TEST NO.6 — 1991 4RUNNER WITH 22R-E, 4WD WITH AUTO TRANS



## ECU TEST NO.7 — 1991 4RUNNER WITH 22R-E, 4WD WITH AUTO TRANS

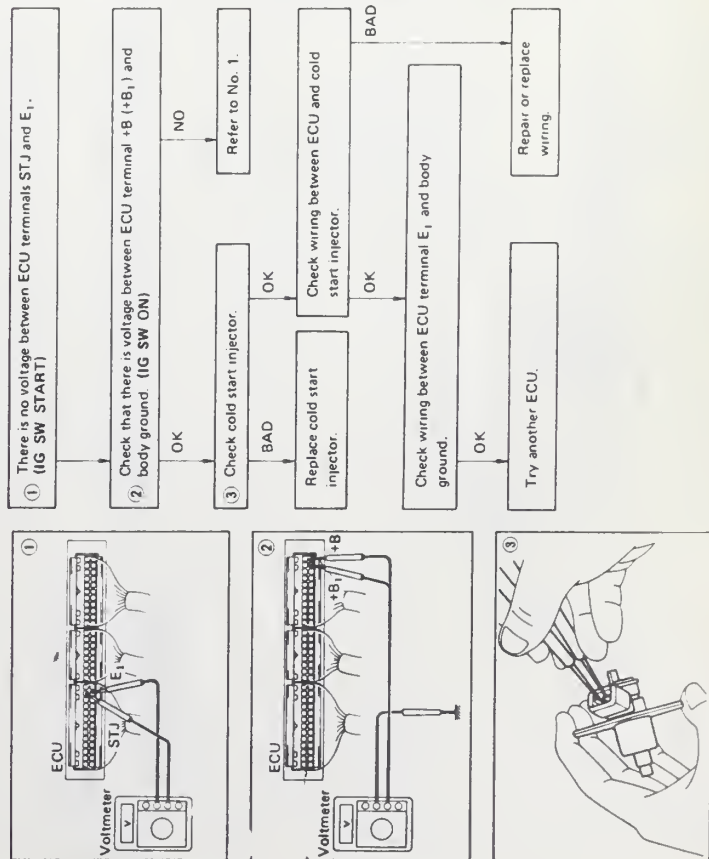
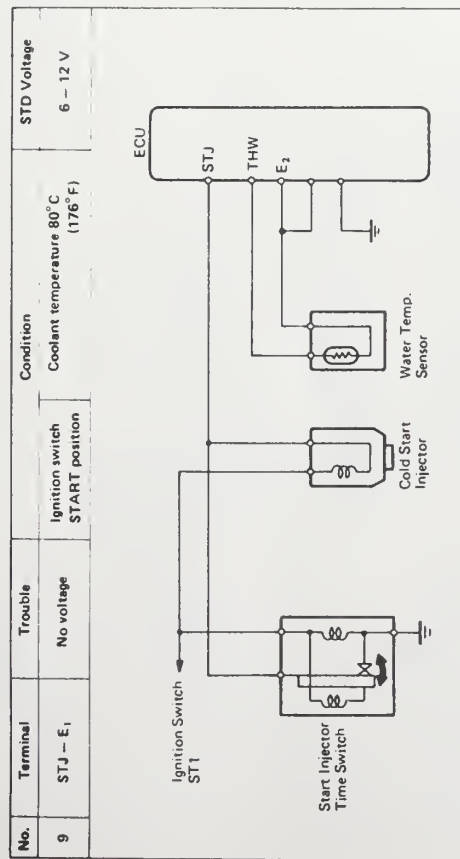


## ECU TEST NO.8 — 1991 4RUNNER WITH 22R-E, 4WD WITH AUTO TRANS

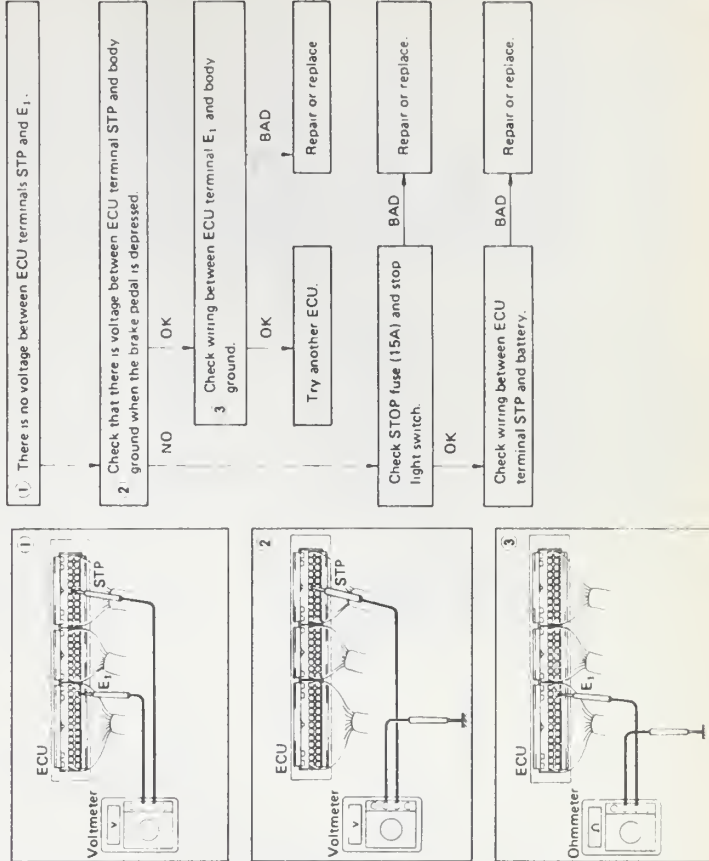
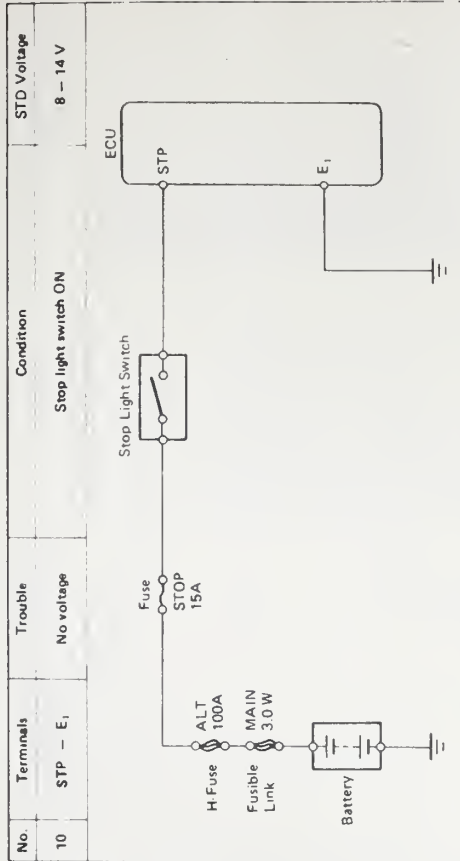


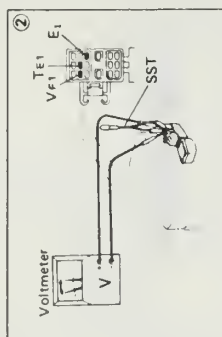
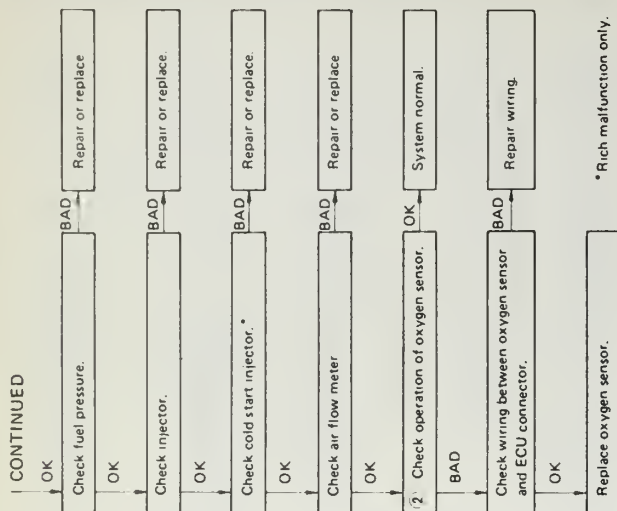
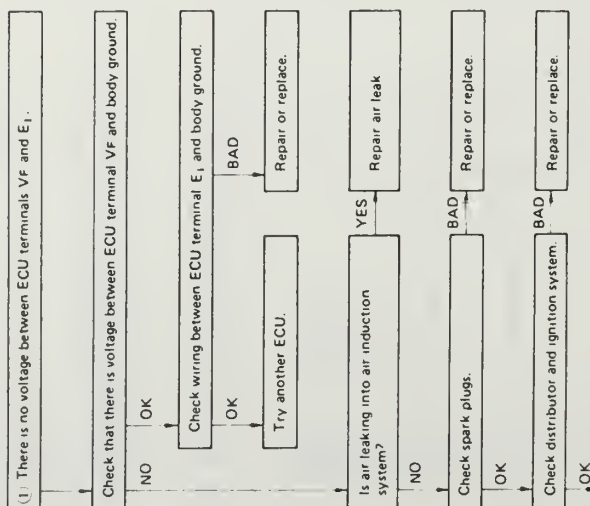
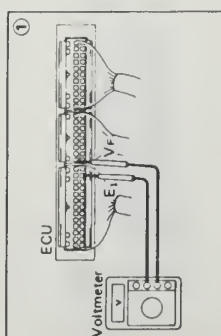
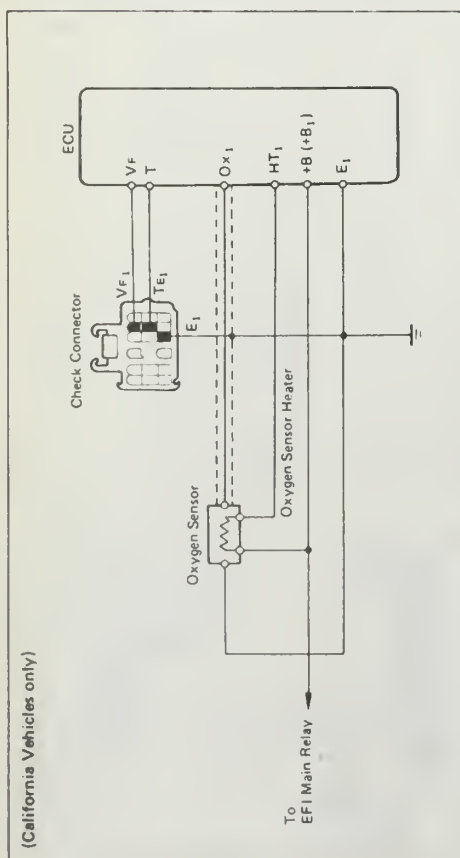


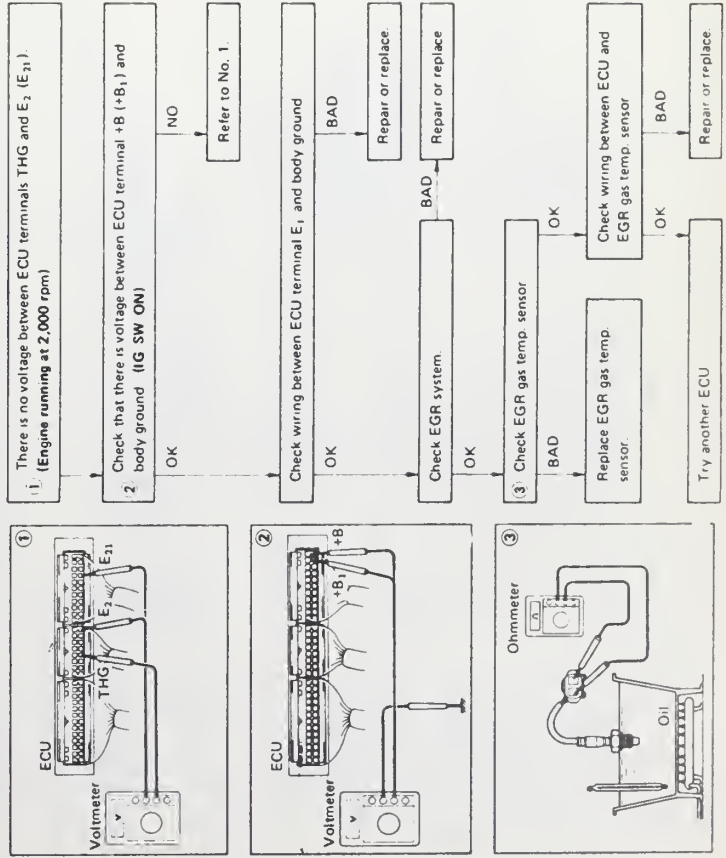
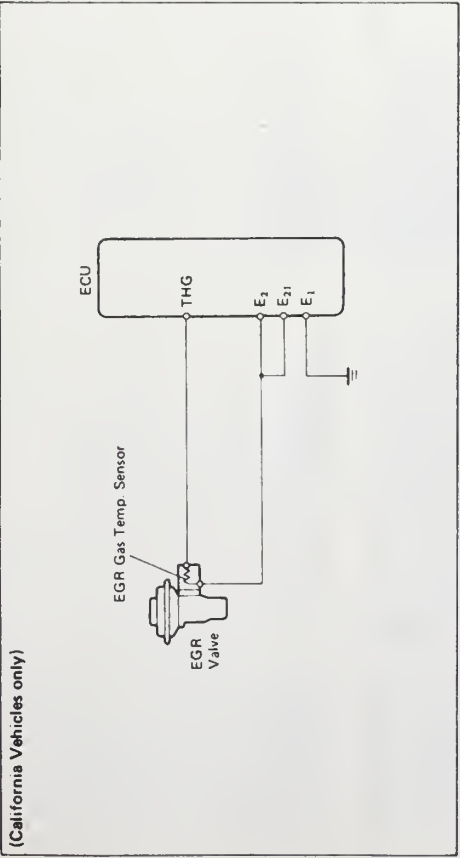
# ECU TEST NO.9 — 1991 4RUNNER WITH 22R-E, 4WD WITH AUTO TRANS



# ECU TEST NO.10 — 1991 4RUNNER WITH 22R-E, 4WD WITH AUTO TRANS



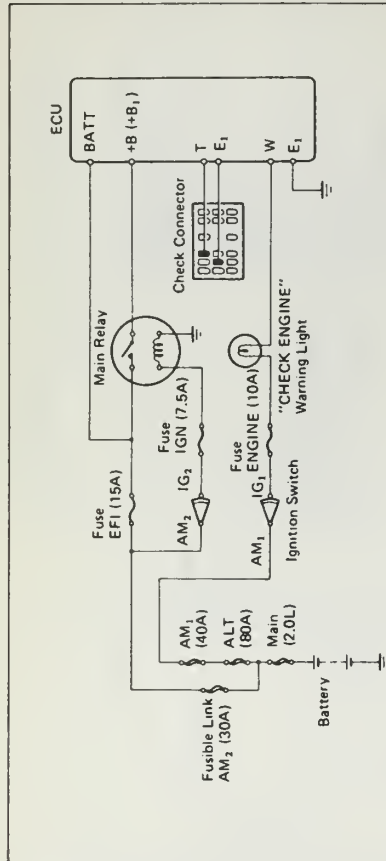




| Code No. | Number of blinks "CHECK ENGINE" | System                         | Diagnosis                                                                                                                                     | Trouble area                                                                                                                                                                         |
|----------|---------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11       | ON OFF (1.000)                  | Normal                         | This appears when none of the other codes are identified.                                                                                     | • IG switch circuit<br>• IG switch<br>• Main relay circuit<br>• Main relay<br>• ECU                                                                                                  |
| 12       | ECU (+B)                        | ECU (+B)                       | Momentary interruption in power supply to ECU                                                                                                 | • Distributor circuit<br>• Distributor<br>• Starter signal circuit<br>• ECU                                                                                                          |
| 13       | RPM Signal                      | RPM Signal                     | NO "Ne" signal to ECU within 2 seconds after the engine is cranked                                                                            | • Distributor circuit<br>• Distributor<br>• Starter signal circuit<br>• ECU                                                                                                          |
| 14       | RPM Signal                      | RPM Signal                     | NO "Ne" signal to ECU when engine speed is above 1,000 rpm.                                                                                   | • Distributor circuit<br>• Distributor<br>• Starter signal circuit<br>• ECU                                                                                                          |
| 21       | Ignition Signal                 | Ignition Signal                | NO "IG" signal to ECU 6 - 8 times in succession.                                                                                              | • Igniter and ignition coil circuit<br>• Igniter and ignition coil<br>• Oxygen sensor circuit<br>• Oxygen sensor<br>• ECU                                                            |
| 22       | Oxygen Sensor Signal            | Oxygen Sensor Signal           | Detection of oxygen sensor deterioration.                                                                                                     | • Oxygen sensor heater circuit<br>• Oxygen sensor heater<br>• ECU                                                                                                                    |
| 24       | Water Temp Sensor Signal        | Water Temp Sensor Signal       | Open or short circuit in oxygen sensor heater signal (HT).                                                                                    | • Water temp. sensor circuit<br>• Water temp. sensor<br>• ECU                                                                                                                        |
| 25       | Intake Air Temp. Sensor Signal  | Intake Air Temp. Sensor Signal | Open or short circuit in water temp. sensor signal (THW).                                                                                     | • Water temp. sensor circuit<br>• Water temp. sensor<br>• ECU                                                                                                                        |
| 26       | Fuel Malfunction Signal         | Fuel Malfunction Signal        | Open or short circuit in intake air temp. sensor signal (THA).                                                                                | • Intake air temp. sensor circuit<br>• Intake air temp. sensor<br>• ECU                                                                                                              |
| 27       | Fuel Malfunction Signal         | Fuel Malfunction Signal        | When the air-fuel ratio feedback correction value or adaptive control valve feedback frequency is abnormally high during feed back condition. | • Injector circuit<br>• Injector<br>• Fuel line pressure<br>• Ignition system<br>• Oxygen sensor circuit<br>• Oxygen sensor<br>• Air flow meter<br>• Water temp. sensor<br>• ECU     |
| 28       | Fuel Malfunction Signal         | Fuel Malfunction Signal        | Open circuit in oxygen sensor signal (Ox).                                                                                                    | • Injector circuit<br>• Injector<br>• Fuel line pressure<br>• Cold start injector<br>• Air-flow meter<br>• ECU<br>(Federal and Canada)<br>• Oxygen sensor circuit<br>• Oxygen sensor |



| Code No. | Number of blinks "CHECK ENGINE" | System                          | Diagnosis                                                                                                                                                                                                  | Trouble area                                                                                                                                                                                             |
|----------|---------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31       |                                 | Air Flow, Meter Signal          | <ul style="list-style-type: none"> <li>Open circuit in Vc signal or short circuit between V<sub>1</sub> and E<sub>2</sub>.</li> <li>When idle contacts are closed.</li> </ul>                              | <ul style="list-style-type: none"> <li>Air flow meter circuit</li> <li>Air flow meter</li> <li>ECU</li> </ul>                                                                                            |
| 32       |                                 | Air flow Meter Signal           | <ul style="list-style-type: none"> <li>Open circuit in E<sub>2</sub> or short circuit between Vc and Vs.</li> </ul>                                                                                        | <ul style="list-style-type: none"> <li>Air flow meter circuit</li> <li>Air flow meter</li> <li>ECU</li> </ul>                                                                                            |
| 35       | (C & C only)<br>                | HAC Sensor Signal               | <ul style="list-style-type: none"> <li>Open circuit in HAC sensor signal.</li> </ul>                                                                                                                       | <ul style="list-style-type: none"> <li>ECU</li> </ul>                                                                                                                                                    |
| 41       |                                 | Throttle Position Sensor Signal | <ul style="list-style-type: none"> <li>Open or short circuit in throttle position sensor signal (VTA).</li> </ul>                                                                                          | <ul style="list-style-type: none"> <li>Throttle position sensor circuit</li> <li>Throttle position sensor</li> <li>ECU</li> </ul>                                                                        |
| 42       |                                 | Vehicle Speed Sensor Signal     | <ul style="list-style-type: none"> <li>No "SPD" signal to ECU for 8 seconds when engine speed is between 1,500 rpm and 4,000 rpm and coolant temp. is above 80°C except when racing the engine.</li> </ul> | <ul style="list-style-type: none"> <li>Vehicle speed sensor circuit</li> <li>Vehicle speed sensor</li> <li>ECU</li> </ul>                                                                                |
| 43       |                                 | Starter Signal                  | <ul style="list-style-type: none"> <li>NO "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moving.</li> </ul>                                                                       | <ul style="list-style-type: none"> <li>IG switch circuit</li> <li>IG switch</li> <li>ECU</li> </ul>                                                                                                      |
| 52       |                                 | Knock Sensor Signal             | <ul style="list-style-type: none"> <li>Open circuit in knock sensor signal (KNK).</li> </ul>                                                                                                               | <ul style="list-style-type: none"> <li>Knock sensor circuit</li> <li>Knock sensor</li> <li>ECU</li> </ul>                                                                                                |
| 53       |                                 | Knock Control Signal in ECU     | <ul style="list-style-type: none"> <li>Knock control program faulty.</li> </ul>                                                                                                                            | <ul style="list-style-type: none"> <li>ECU</li> </ul>                                                                                                                                                    |
| 71       | (California only)<br>           | EGR System Malfunction          | <ul style="list-style-type: none"> <li>EGR gas temp. below predetermined level during EGR operation.</li> <li>Open circuit EGR gas temp. sensor signal (THG).</li> </ul>                                   | <ul style="list-style-type: none"> <li>EGR valve</li> <li>EGR hose</li> <li>EGR gas temp. sensor circuit</li> <li>EGR gas temp. sensor</li> <li>VSV for EGR circuit</li> <li>ECU</li> </ul>              |
| 51       |                                 | Switch Signal                   | <ul style="list-style-type: none"> <li>Air conditioner switch ON, idle switch OFF during diagnosis check.</li> </ul>                                                                                       | <ul style="list-style-type: none"> <li>A/C switch circuit</li> <li>A/C switch</li> <li>A/C Amplifier</li> <li>Throttle position sensor circuit</li> <li>Throttle position sensor</li> <li>ECU</li> </ul> |



1. Does CHECK ENG. light come on when ignition switch is at ON?

YES

System Normal

Does CHECK ENG. light come on when ECU terminal W is grounded to the body?

YES

Check wiring between ECU terminal E<sub>1</sub> and body ground.

OK

Try another ECU.

Check bulb, fuse and wiring between ECU and ignition switch.

BAD

Repair or replace

System Normal

Does CHECK ENG. light go OFF when engine is started?

YES

System Normal

Check wiring between ECU and CHECK ENG. light.

BAD

Repair

System Normal

Is there diagnosis code output when check connector T<sub>E1</sub> and E<sub>1</sub> is connect circuited?

NO

Try another ECU.

System Normal

Does CHECK ENG. light go out after repair according to malfunction code?

NO

Further repair required.

System Normal

System OK

Cancel out diagnostic code.

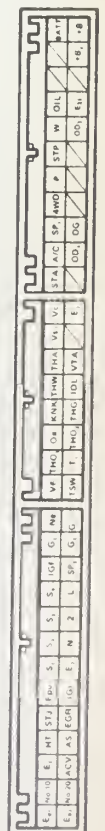
System Normal

System Normal

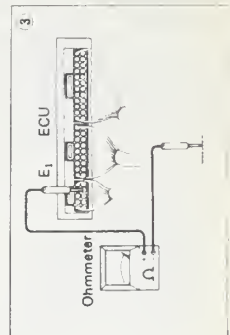
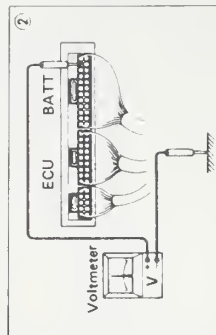
|          |    |     |   |  |               |             |                |                |               |      |     |   |            |   |   |  |          |  |  |     |     |     |                |                |                 |
|----------|----|-----|---|--|---------------|-------------|----------------|----------------|---------------|------|-----|---|------------|---|---|--|----------|--|--|-----|-----|-----|----------------|----------------|-----------------|
| $E_{90}$ | No | STA | J |  | FPU           | G $\ominus$ | G <sub>i</sub> | G <sub>j</sub> | N $\emptyset$ | H    | T   | I | G $\Gamma$ | H | W |  | Ox       |  |  | SPD | STP | THA | V <sub>i</sub> | V <sub>c</sub> | BATT            |
| $E_{98}$ | No |     |   |  | $\ddagger$ HG | ACV         | V $\Phi$       | T              | VT            | AIDL | EGR |   |            |   |   |  | $E_{31}$ |  |  | A/C | W   | AS  | KVK/WQTSW      | -B             | +B <sub>i</sub> |
|          | 10 |     |   |  |               |             |                |                |               |      |     |   |            |   |   |  | $E_2$    |  |  |     |     |     |                |                |                 |

## ECU TERMINALS – 1989 TRUCK AND 4RUNNER WITH 3VZ-E, AUTOMATIC TRANS OR C&C WITH MANUAL TRANS

|      | * <sup>1</sup> A/T only | * <sup>2</sup> 4WD A/T only | * <sup>3</sup> California only |
|------|-------------------------|-----------------------------|--------------------------------|
| 1997 | 10                      | 10                          | 10                             |
| 1998 | 10                      | 10                          | 10                             |
| 1999 | 10                      | 10                          | 10                             |
| 2000 | 10                      | 10                          | 10                             |
| 2001 | 10                      | 10                          | 10                             |
| 2002 | 10                      | 10                          | 10                             |
| 2003 | 10                      | 10                          | 10                             |
| 2004 | 10                      | 10                          | 10                             |
| 2005 | 10                      | 10                          | 10                             |
| 2006 | 10                      | 10                          | 10                             |
| 2007 | 10                      | 10                          | 10                             |
| 2008 | 10                      | 10                          | 10                             |
| 2009 | 10                      | 10                          | 10                             |
| 2010 | 10                      | 10                          | 10                             |
| 2011 | 10                      | 10                          | 10                             |
| 2012 | 10                      | 10                          | 10                             |
| 2013 | 10                      | 10                          | 10                             |
| 2014 | 10                      | 10                          | 10                             |
| 2015 | 10                      | 10                          | 10                             |
| 2016 | 10                      | 10                          | 10                             |
| 2017 | 10                      | 10                          | 10                             |
| 2018 | 10                      | 10                          | 10                             |
| 2019 | 10                      | 10                          | 10                             |
| 2020 | 10                      | 10                          | 10                             |
| 2021 | 10                      | 10                          | 10                             |
| 2022 | 10                      | 10                          | 10                             |
| 2023 | 10                      | 10                          | 10                             |
| 2024 | 10                      | 10                          | 10                             |
| 2025 | 10                      | 10                          | 10                             |
| 2026 | 10                      | 10                          | 10                             |
| 2027 | 10                      | 10                          | 10                             |
| 2028 | 10                      | 10                          | 10                             |
| 2029 | 10                      | 10                          | 10                             |
| 2030 | 10                      | 10                          | 10                             |
| 2031 | 10                      | 10                          | 10                             |
| 2032 | 10                      | 10                          | 10                             |
| 2033 | 10                      | 10                          | 10                             |
| 2034 | 10                      | 10                          | 10                             |
| 2035 | 10                      | 10                          | 10                             |
| 2036 | 10                      | 10                          | 10                             |
| 2037 | 10                      | 10                          | 10                             |
| 2038 | 10                      | 10                          | 10                             |
| 2039 | 10                      | 10                          | 10                             |
| 2040 | 10                      | 10                          | 10                             |
| 2041 | 10                      | 10                          | 10                             |
| 2042 | 10                      | 10                          | 10                             |
| 2043 | 10                      | 10                          | 10                             |
| 2044 | 10                      | 10                          | 10                             |
| 2045 | 10                      | 10                          | 10                             |
| 2046 | 10                      | 10                          | 10                             |
| 2047 | 10                      | 10                          | 10                             |
| 2048 | 10                      | 10                          | 10                             |
| 2049 | 10                      | 10                          | 10                             |
| 2050 | 10                      | 10                          | 10                             |
| 2051 | 10                      | 10                          | 10                             |
| 2052 | 10                      | 10                          | 10                             |
| 2053 | 10                      | 10                          | 10                             |
| 2054 | 10                      | 10                          | 10                             |
| 2055 | 10                      | 10                          | 10                             |
| 2056 | 10                      | 10                          | 10                             |
| 2057 | 10                      | 10                          | 10                             |
| 2058 | 10                      | 10                          | 10                             |
| 2059 | 10                      | 10                          | 10                             |
| 2060 | 10                      | 10                          | 10                             |
| 2061 | 10                      | 10                          | 10                             |
| 2062 | 10                      | 10                          | 10                             |
| 2063 | 10                      | 10                          | 10                             |
| 2064 | 10                      | 10                          | 10                             |
| 2065 | 10                      | 10                          | 10                             |
| 2066 | 10                      | 10                          | 10                             |
| 2067 | 10                      | 10                          | 10                             |
| 2068 | 10                      | 10                          | 10                             |
| 2069 | 10                      | 10                          | 10                             |
| 2070 | 10                      | 10                          | 10                             |
| 2071 | 10                      | 10                          | 10                             |
| 2072 | 10                      | 10                          | 10                             |
| 2073 | 10                      | 10                          | 10                             |
| 2074 | 10                      | 10                          | 10                             |
| 2075 | 10                      | 10                          | 10                             |
| 2076 | 10                      | 10                          | 10                             |
| 2077 | 10                      | 10                          | 10                             |
| 2078 | 10                      | 10                          | 10                             |
| 2079 | 10                      | 10                          | 10                             |
| 2080 | 10                      | 10                          | 10                             |
| 2081 | 10                      | 10                          | 10                             |
| 2082 | 10                      | 10                          | 10                             |
| 2083 | 10                      | 10                          | 10                             |
| 2084 | 10                      | 10                          | 10                             |
| 2085 | 10                      | 10                          | 10                             |
| 2086 | 10                      | 10                          | 10                             |
| 2087 | 10                      | 10                          | 10                             |
| 2088 | 10                      | 10                          | 10                             |
| 2089 | 10                      | 10                          | 10                             |
| 2090 | 10                      | 10                          | 10                             |
| 2091 | 10                      | 10                          | 10                             |
| 2092 | 10                      | 10                          | 10                             |
| 2093 | 10                      | 10                          | 10                             |
| 2094 | 10                      | 10                          | 10                             |



- BATT - E<sub>1</sub>



① No voltage between ECU terminals BATT and E<sub>1</sub>.

① No voltage between ECU terminals BATT and E<sub>1</sub>.

(2) Check that there is voltage between ECU terminal BATT and body ground.

NO OK

③ Check wiring between ECU terminal E<sub>1</sub> and

```

graph TD
 Repair[Repair] --> OK[OK]
 OK --> TryECU[Try another ECU.]
 TryECU --> Repair

```

```

graph TD
 A[Check fuse and fusible link.] -- BAD --> B[Replace]

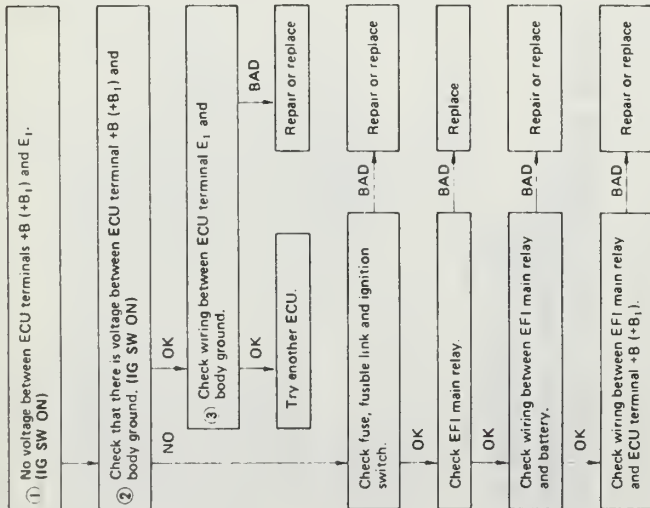
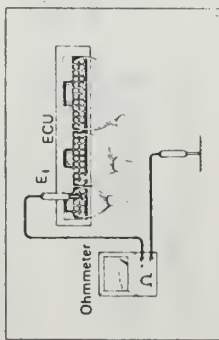
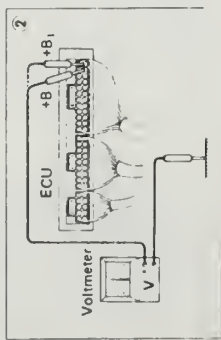
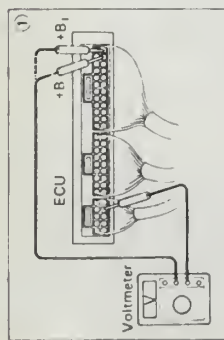
```

Check wiring between fuse and ECU.

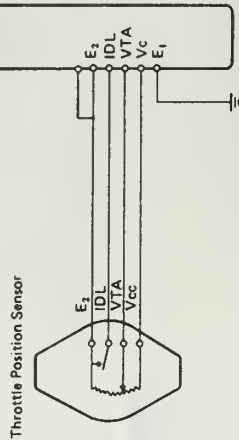
# ECU TEST NO.1: (CONTINUED)

# ECU TEST NO.2 — 1989 TRUCK AND 4RUNNER WITH 3VZ-E, MANUAL TRANS, EXCEPT C&C

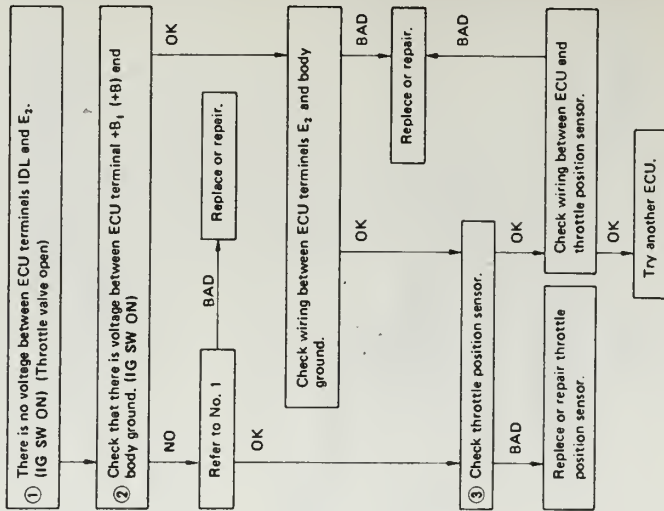
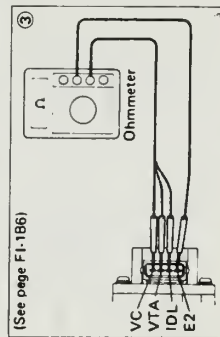
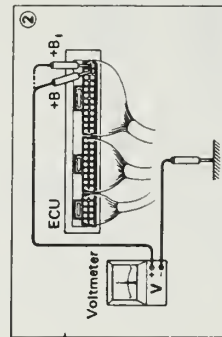
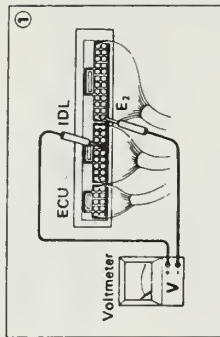
• +B (+B<sub>1</sub>) - E<sub>1</sub>



| No. | Terminals                       | Trouble    | Condition                   | STD Voltage |
|-----|---------------------------------|------------|-----------------------------|-------------|
| 2   | IDL - E <sub>2</sub>            | No voltage | Throttle valve open         | 8 - 14 V    |
|     | V <sub>c</sub> - E <sub>2</sub> |            | Throttle valve fully closed | 4 - 6 V     |
|     | VTA - E <sub>2</sub>            |            | Throttle valve fully open   | 0.1 - 1.0 V |
|     |                                 |            | Throttle valve fully open   | 3 - 5 V     |



• IDL - E<sub>2</sub>





• VTA - E<sub>2</sub>

① There is no specified voltage at ECU terminals VTA and E<sub>2</sub>.  
(IG SW ON)

② Check that there is voltage between ECU terminals Vc and E<sub>2</sub>.  
(IG SW ON)

OK →

NO → Perform inspection of Vc - E<sub>2</sub>

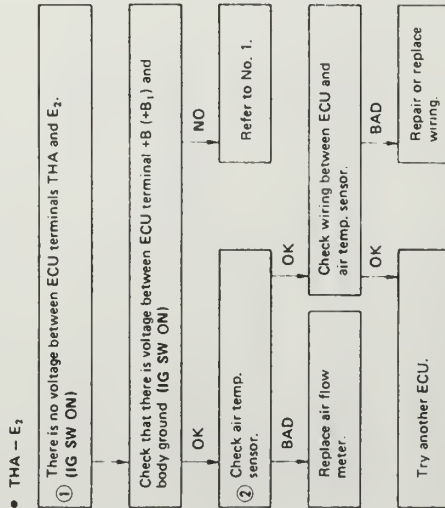
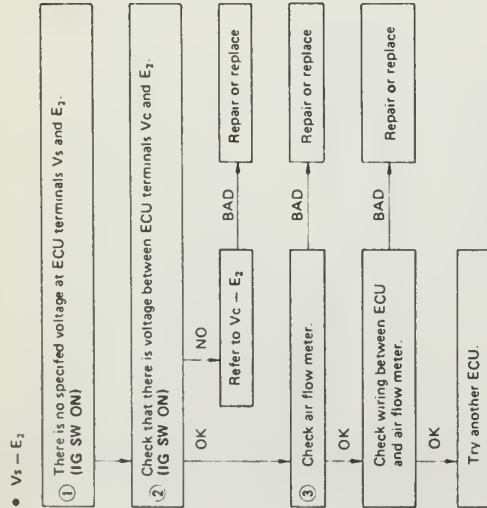
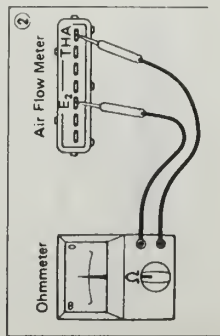
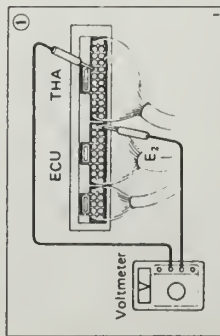
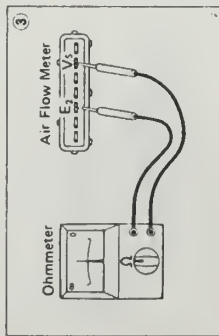
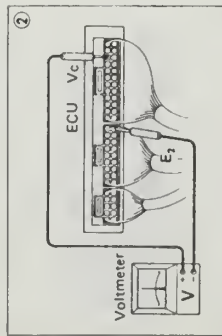
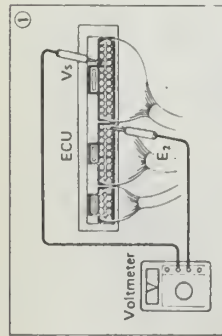
③ Check throttle position sensor.

BAD → Repair or replace

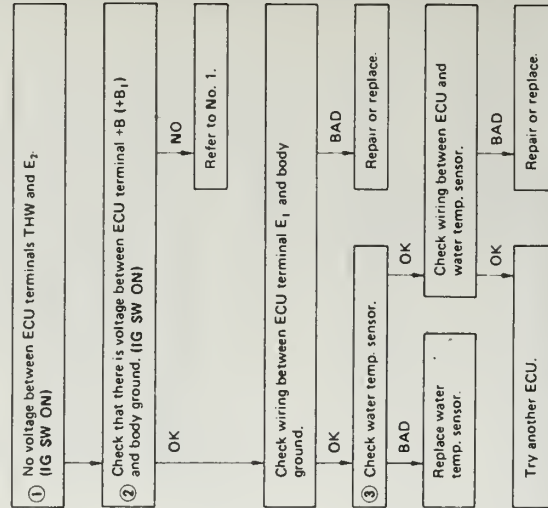
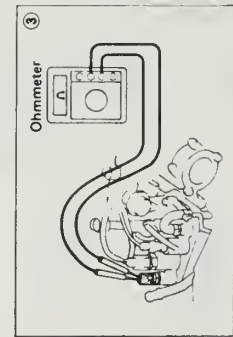
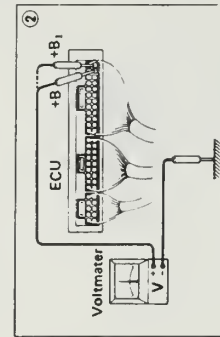
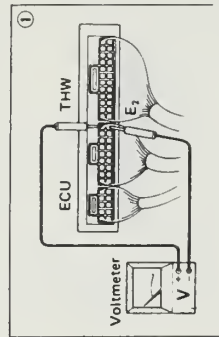
OK → Check wiring between ECU and throttle position sensor.

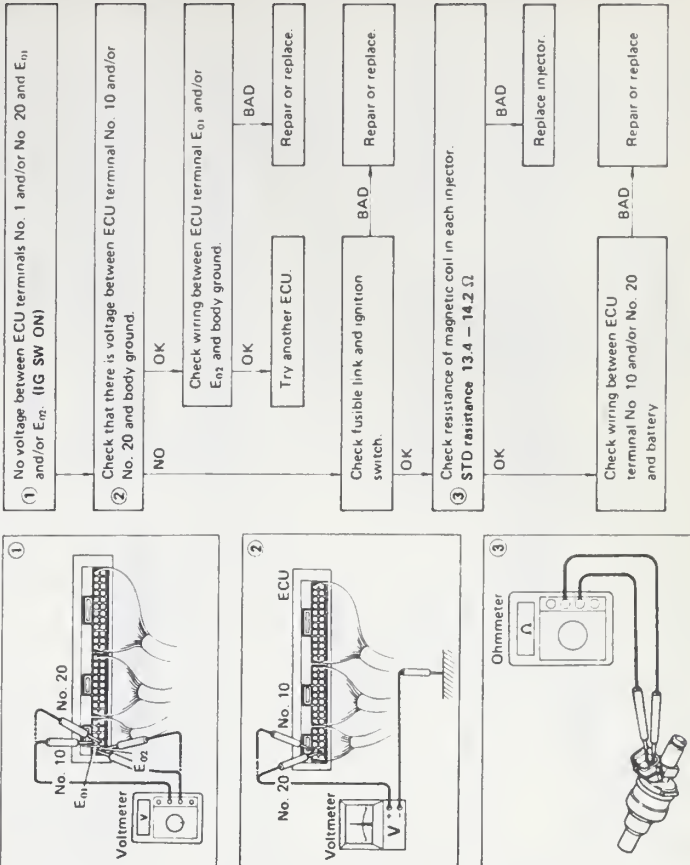
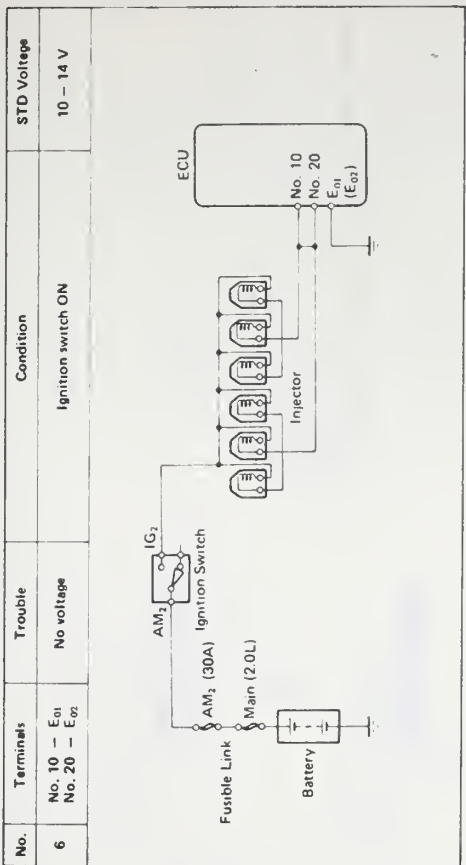
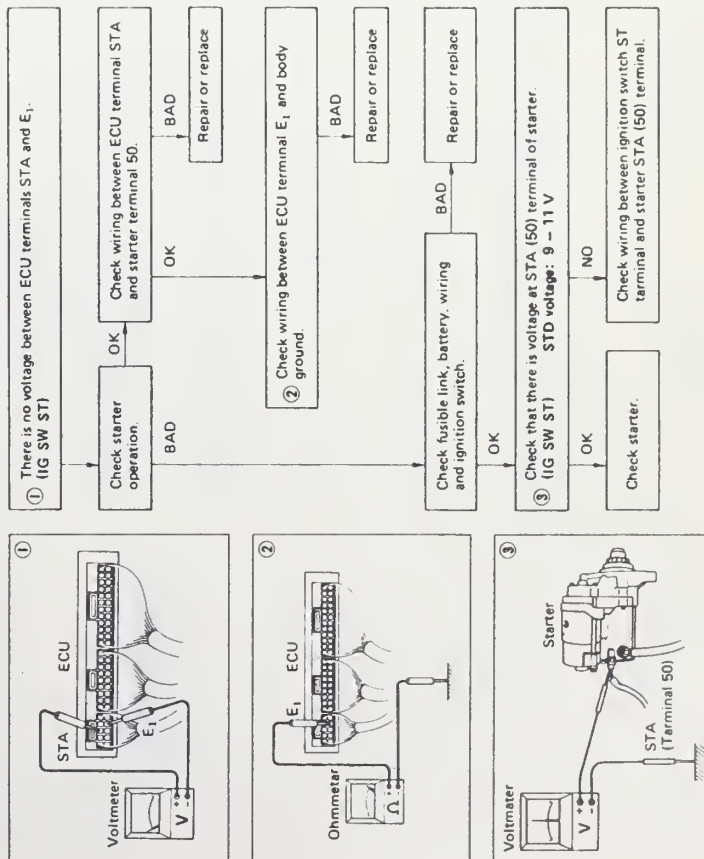
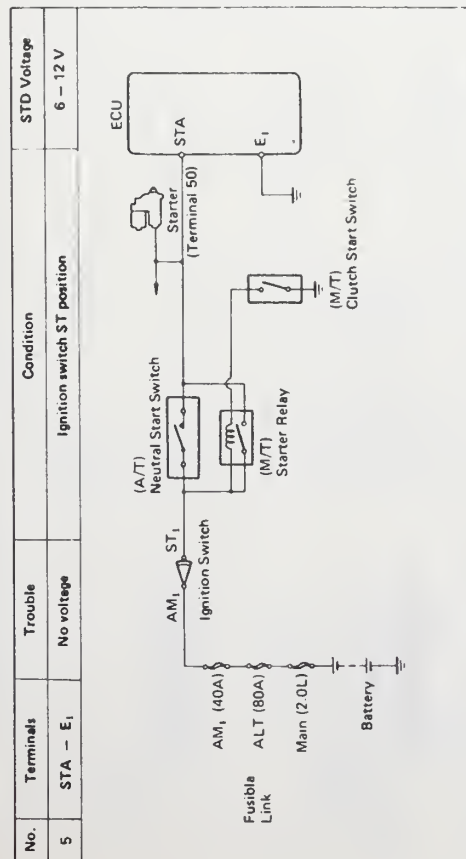
BAD → Repair or replace.

OK → Try another ECU.



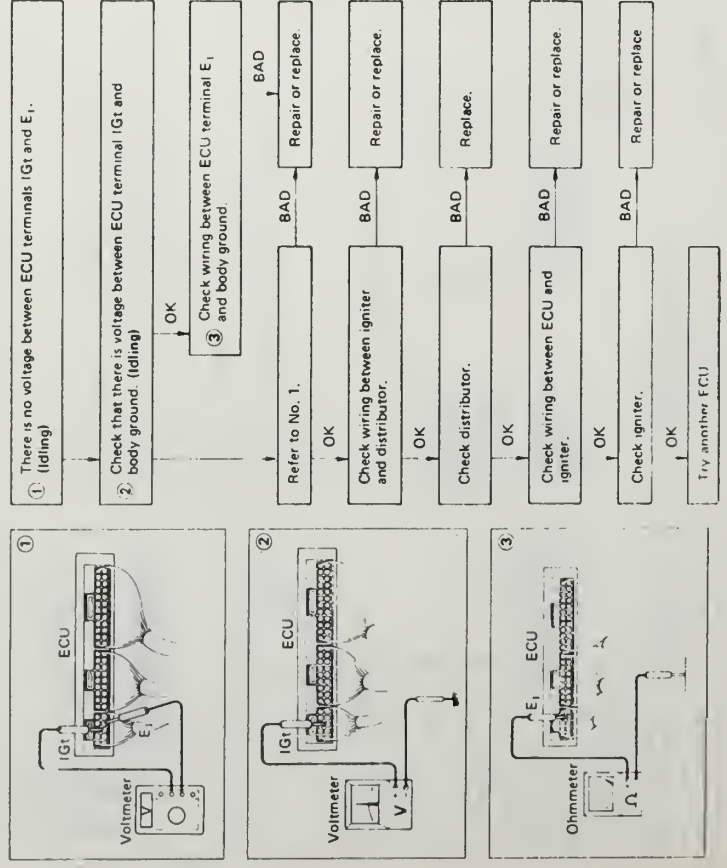
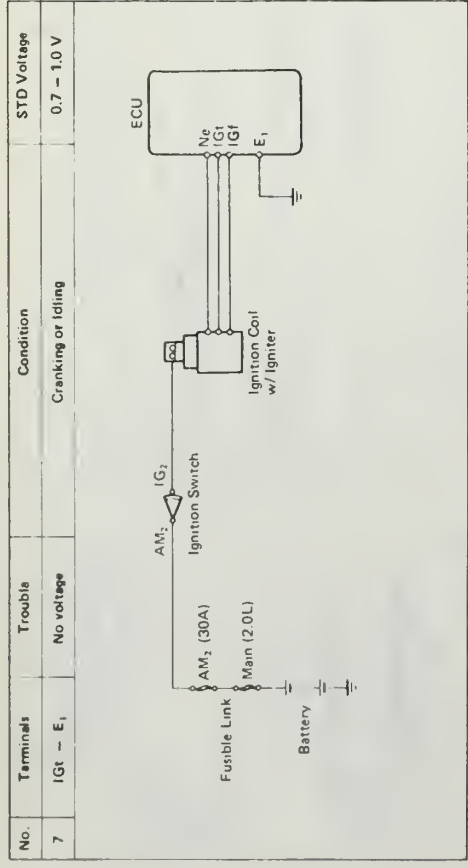
| No. | Terminals   | Trouble    | Condition                                              | STO Voltage |
|-----|-------------|------------|--------------------------------------------------------|-------------|
| 4   | THW - $E_2$ | No voltage | Ignition switch ON<br>Coolant temperature 80°C (176°F) | 0.1 - 1.0 V |



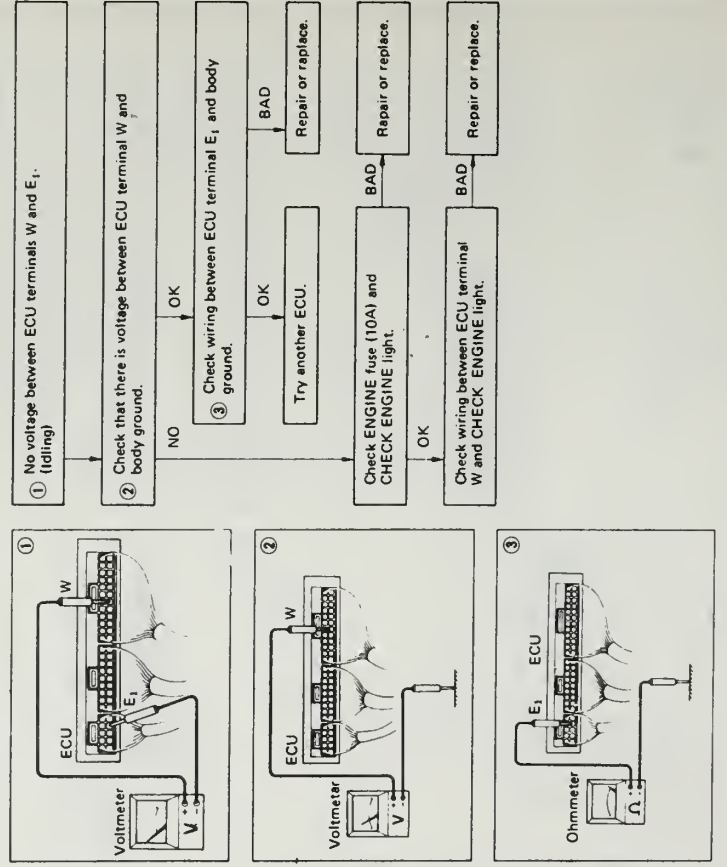
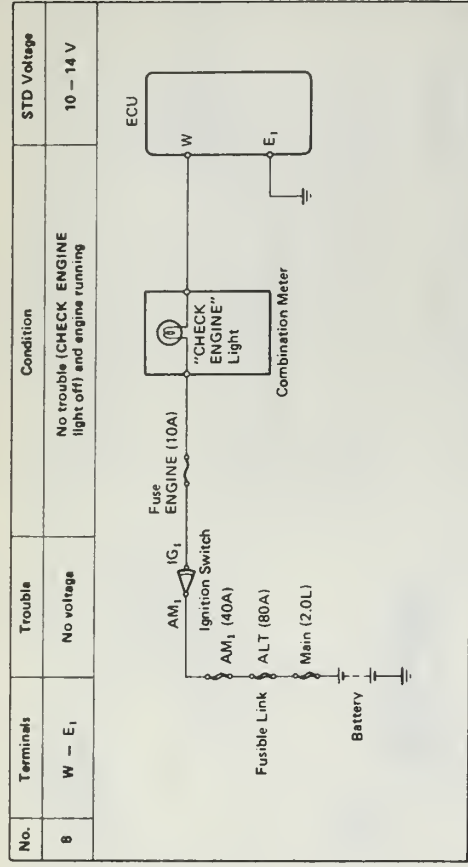




# ECU TEST NO.7 — 1989 TRUCK AND 4RUNNER WITH 3VZ-E, MANUAL TRANS, EXCEPT C&C



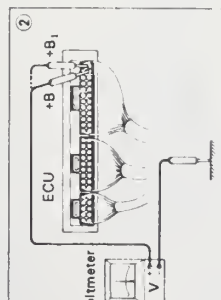
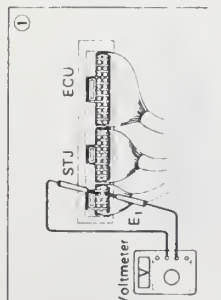
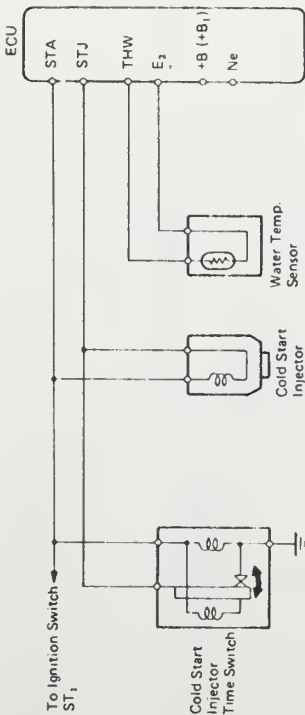
# ECU TEST NO.8 — 1989 TRUCK AND 4RUNNER WITH 3VZ-E, MANUAL TRANS, EXCEPT C&C



**ECU TEST NO.10 – 1989 TRUCK AND 4RUNNER WITH  
3VZ-E, MANUAL TRANS, EXCEPT C&C**

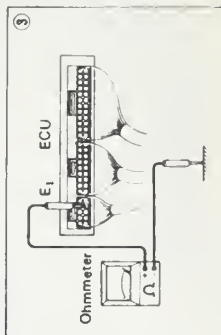
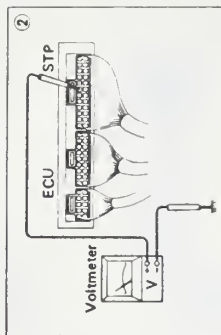
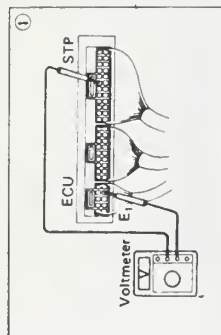
**ECU TEST NO.9 – 1989 TRUCK AND 4RUNNER WITH  
3VZ-E, MANUAL TRANS, EXCEPT C&C**

| No. | Terminals            | Trouble    | Condition                             | STD Voltage |
|-----|----------------------|------------|---------------------------------------|-------------|
| 9   | STJ - E <sub>1</sub> | No voltage | Coolant temperature<br>80 °C (176 °F) | 6 - 12 V    |



- ```

graph TD
    Start([START]) --> Step1[1. No voltage between ECU terminals STJ and E1.  
(IG SW ON)]
    Step1 --> Step2[2. Check that there is voltage between ECU terminal +B (+B1) and  
body ground. (IG SW ON)]
    Step2 -- OK --> Step3[3. Check cold start injector.]
    Step2 -- NO --> Ref1[Refer to No. 1.]
    Step3 -- OK --> Step4[Check wiring between ECU and  
cold start injector.]
    Step3 -- BAD --> Step5[Replace cold start  
injector]
    Step4 -- OK --> Step6[Check wiring between ECU terminal E1 and body ground.]
    Step4 -- BAD --> Step7[Repair or replace  
wiring]
    Step5 --> Step6
    Step6 -- OK --> Step8[Try another ECU.]
    Step6 --> Step7
    Step7 --> Step8
    Step8 --> End([END])
  
```

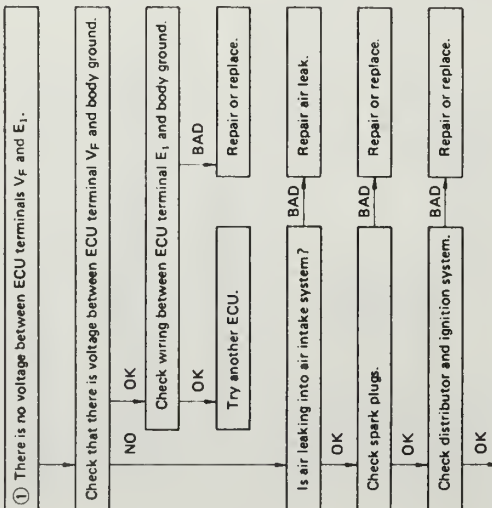
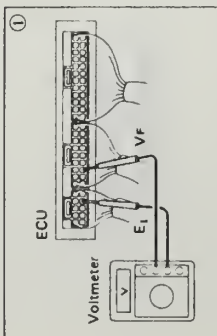
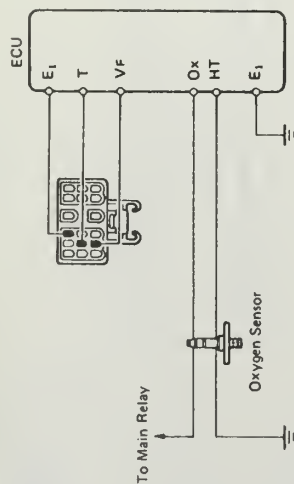


- ```

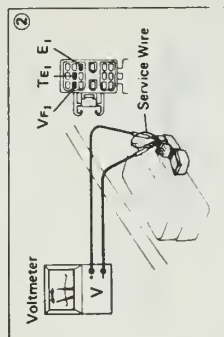
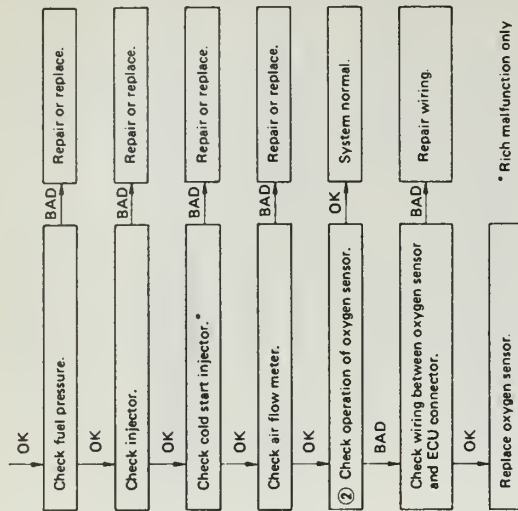
graph TD
 Start([START]) --> Step1{1 No voltage between ECU terminals STP and E1}
 Step1 --> Step2{2 Check that there is voltage between ECU terminal STP and body ground when the brake pedal is depressed}
 Step2 -- NO --> Step3{3 Check wiring between ECU terminal E1 and body ground}
 Step2 -- OK --> Step4{Check STOP fuse (15A) and stop light switch}
 Step3 -- OK --> Step5[Try another ECU]
 Step3 -- BAD --> Step6[Repair or replace]
 Step4 -- OK --> Step7{Check wiring between ECU terminal STP and battery}
 Step4 -- BAD --> Step8[Repair or replace]
 Step5 --> Step7
 Step7 -- OK --> End([END])
 Step7 -- BAD --> Step8

```

(California only)



CONTINUED



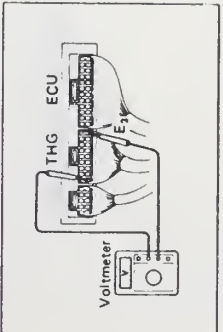
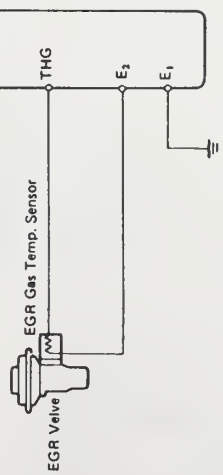
\* Rich malfunction only



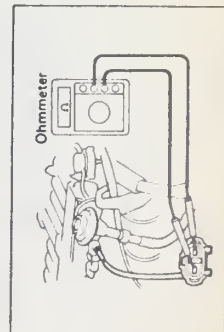
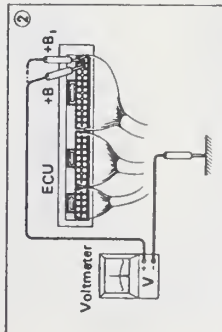
# EGR GAS TEMPERATURE SENSOR TEST – 1989 CALIFORNIA TRUCK AND 4RUNNER WITH 3VZ-E, MANUAL TRANS, EXCEPT C&C

# ECU TEST NO.11 – 1989 TRUCK AND 4RUNNER WITH 3VZ-E, AUTOMATIC TRANS OR C&C WITH MANUAL TRANS. – 1989 TRUCK AND 4RUNNER WITH 3VZ-E, AUTOMATIC TRANS OR C&C WITH MANUAL TRANS

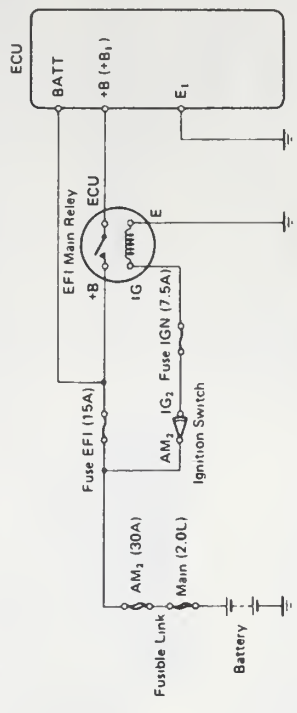
(California only)



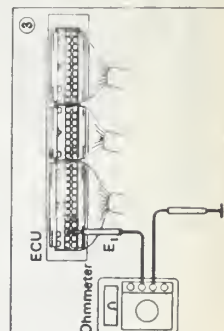
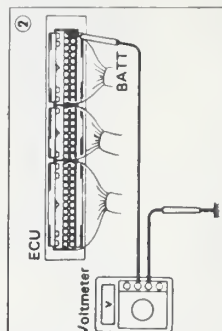
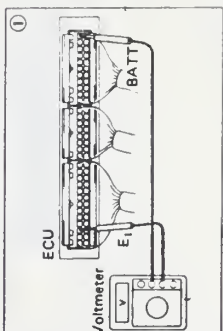
- 1 No voltage between ECU terminals THG and E2.  
(Engine running at 2,000 rpm)
- 2 Check that there is voltage between ECU terminal +B (+B1) and body ground. (IG SW ON)
- 3 Check EGR system.
- 4 Check EGR gas temp. sensor.
- 5 Check wiring between ECU and EGR gas temp. sensor.

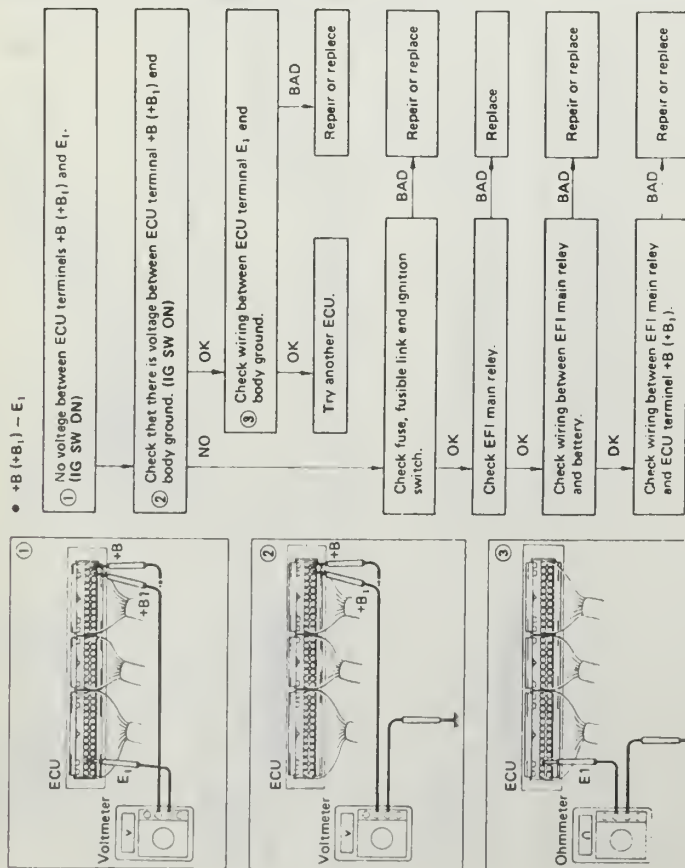


| No. | Terminals                        | Trouble    | Condition          | STD Voltage |
|-----|----------------------------------|------------|--------------------|-------------|
| 11  | BATT – E1<br>+B – E1<br>+B1 – E1 | No voltage | Ignition switch ON | 10 – 14 V   |

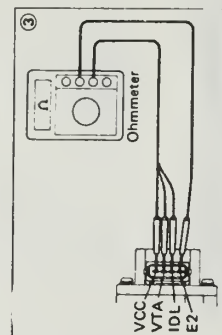
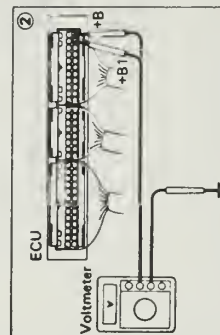
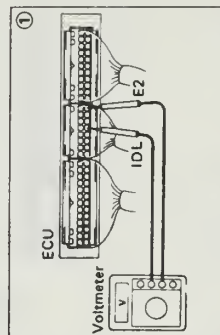
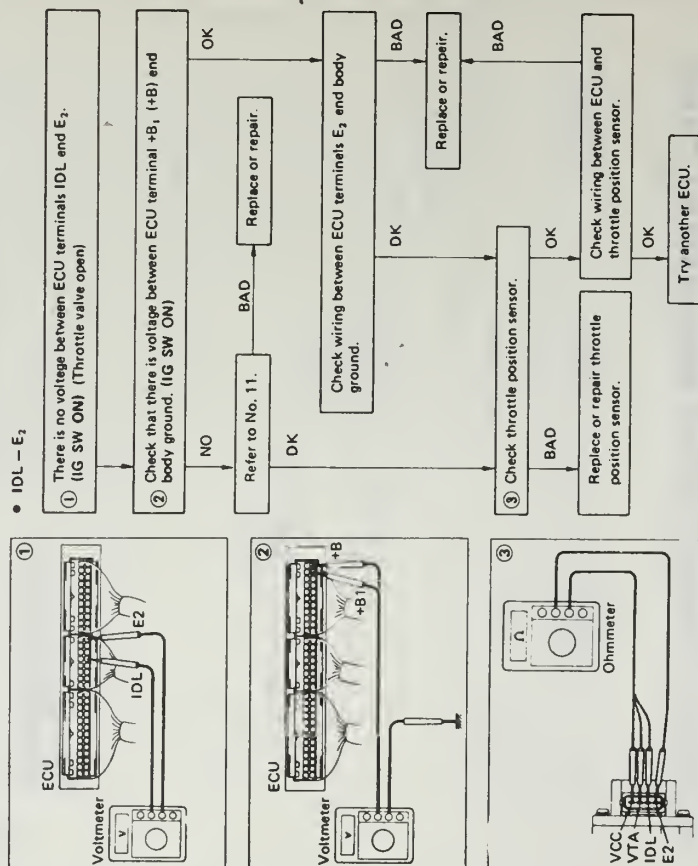
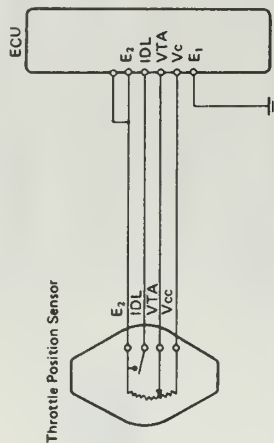


- BATT – E1
- 1 No voltage between ECU terminals BATT and E1.
- 2 Check that there is voltage between ECU terminal BATT and body ground.
- 3 Check wiring between ECU terminal E1 and body ground.
- 4 Try another ECU.
- 5 Check fuse end fusible link.
- 6 Check wiring between fuse end and ECU.



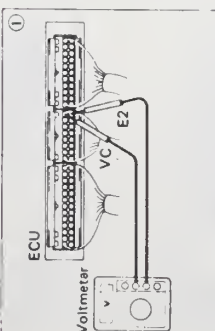


| No. | Terminals            | Trouble    | Condition                   | STD Voltage |
|-----|----------------------|------------|-----------------------------|-------------|
| 12  | IDL - E <sub>2</sub> | No voltage | Throttle valve open         | 8 - 14 V    |
|     | Va - E <sub>2</sub>  |            | Ignition switch ON          | 4 - 6 V     |
|     | VTA - E <sub>2</sub> |            | Throttle valve fully closed | 0.1 - 1.0 V |
|     |                      |            | Throttle valve fully open   | 3 - 5 V     |

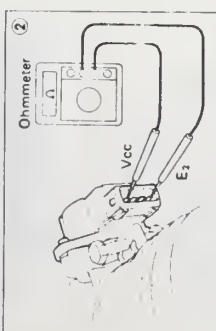


•  $V_{cc} - E_2$

1



2

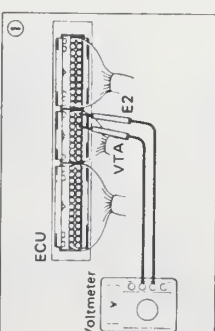


Flowchart:

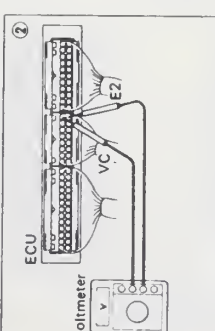
```
graph TD
 Start[There is no voltage between ECU terminals Vc and E2. (IG SW ON)] --> Check1[Check that there is voltage between ECU terminals +B1 (+B) and E1. (IG SW ON)]
 Check1 -- OK --> Check2[Check throttle position sensor.]
 Check2 -- BAD --> Repair1[Repair or replace.]
 Check2 -- OK --> Check3[Check wiring between ECU and throttle position sensor.]
 Check3 -- OK --> TryECU1[Try another ECU.]
 Check3 -- BAD --> Repair2[Repair or replace wiring.]
```

•  $V_{TA} - E_2$

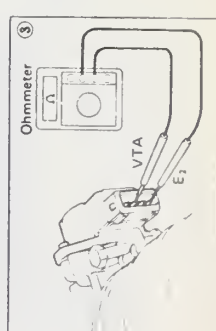
1



2



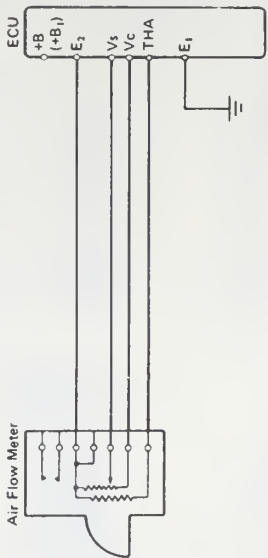
3



Flowchart:

```
graph TD
 Start[There is no specified voltage at ECU terminals VTA and E2. (IG SW ON)] --> Check1[Check that there is voltage between ECU terminals Vc and E2. (IG SW ON)]
 Check1 -- OK --> Check2[Check throttle position sensor.]
 Check2 -- BAD --> Repair1[Repair or replace.]
 Check2 -- OK --> Check3[Check wiring between ECU and throttle position sensor.]
 Check3 -- BAD --> Repair2[Repair or replace.]
 Check3 -- OK --> TryECU2[Try another ECU.]
 Check1 -- NO --> Check4[Perform inspection of Vc - E2]
 Check4 --> Refer11[Refer to No. 11.]
```

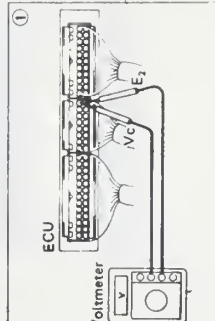
| No. | Terminal                     | Trouble    | Condition      | STD Voltage                        |         |
|-----|------------------------------|------------|----------------|------------------------------------|---------|
| 13  | $V_c - E_2$                  | No voltage | Ignition SW ON | 4 - 6 V                            |         |
|     | Measuring plate fully closed |            | 3.7 - 4.3 V    |                                    |         |
|     | Measuring plate fully open   |            | 0.2 - 0.5 V    |                                    |         |
|     | Idling                       |            | 2.3 - 2.8 V    |                                    |         |
|     |                              |            | 3,000 rpm      | 0.3 - 1.0 V                        |         |
|     |                              |            | IG SW ON       | Intake air temperature 20°C (68°F) | 1 - 3 V |



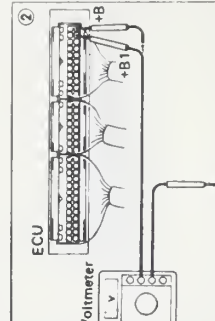
Air Flow Meter

•  $V_c - E_2$

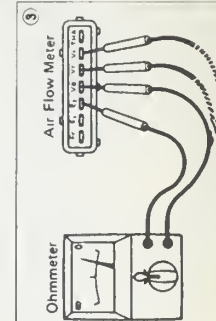
1



2



3



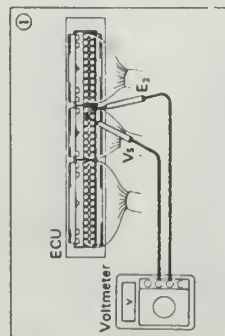
Flowchart:

```
graph TD
 Start[No specified voltage at ECU terminals Vc and E2. (IG SW ON)] --> Check1[Check that there is voltage between ECU terminals +B or +B1 and body ground. (IG SW ON)]
 Check1 -- OK --> Check2[Check air flow meter.]
 Check2 -- NO --> Refer1[Refer to section 1.]
 Check2 -- OK --> Check3[Check wiring between ECU and air flow meter.]
 Check3 -- OK --> TryECU3[Try another ECU.]
 Check3 -- NO --> Repair3[Replace or repair wiring.]
```



# ECU TEST NO.12: (CONTINUED)

# ECU TEST NO.14 - 1989 TRUCK AND 4RUNNER WITH 3VZ-E, AUTOMATIC TRANS OR C&C WITH MANUAL TRANS



• V5 - E3

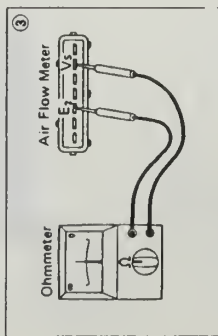
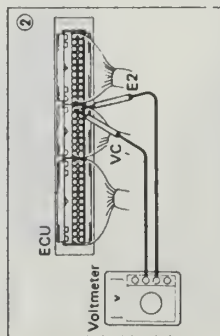
① There is no specified voltage at ECU terminals V5 and E3.  
(IG SW ON)

② Check that there is voltage between ECU terminals Vc and E2.  
(IG SW ON)

OK  
Refer to Vc - E3  
BAD  
Repair or replace

③ Check air flow meter.  
OK  
Check wiring between ECU and air flow meter.  
BAD  
Repair or replace

OK  
Try another ECU.

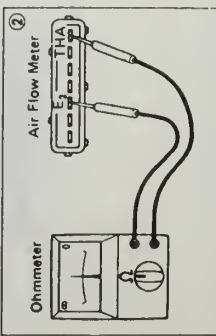
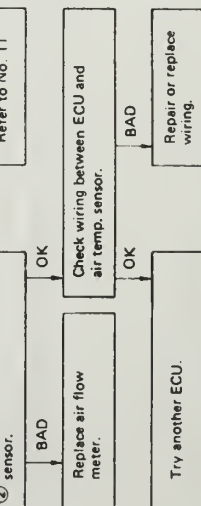


• THA - E3

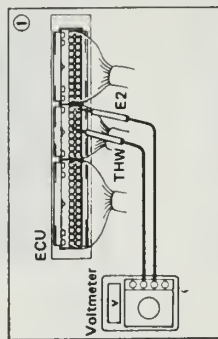
① There is no voltage between ECU terminals THA and E3.  
(IG SW ON)

Check that there is voltage between ECU terminal +B (+B1) and body ground. (IG SW ON)

OK  
Check air temp. sensor.  
BAD  
Replace air flow meter.  
OK  
Check wiring between ECU and air temp. sensor.  
BAD  
Repair or replace wiring.  
Try another ECU.



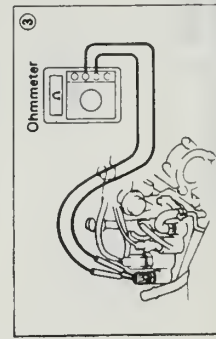
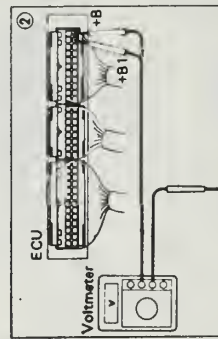
| No. | Terminals | Trouble    | Condition                                              | STD Voltage |
|-----|-----------|------------|--------------------------------------------------------|-------------|
| 14  | THW - E3  | No voltage | Ignition switch ON<br>Coolant temperature 80°C (176°F) | 0.1 - 1.0 V |



① No voltage between ECU terminals THW and E2.  
(IG SW ON)

② Check that there is voltage between ECU terminal +B (+B1) and body ground. (IG SW ON)

OK  
Check wiring between ECU terminal E1 and body ground.  
BAD  
Repair or replace.  
Check water temp. sensor.  
Replace water temp. sensor.  
Check wiring between ECU and water temp. sensor.  
Try another ECU.

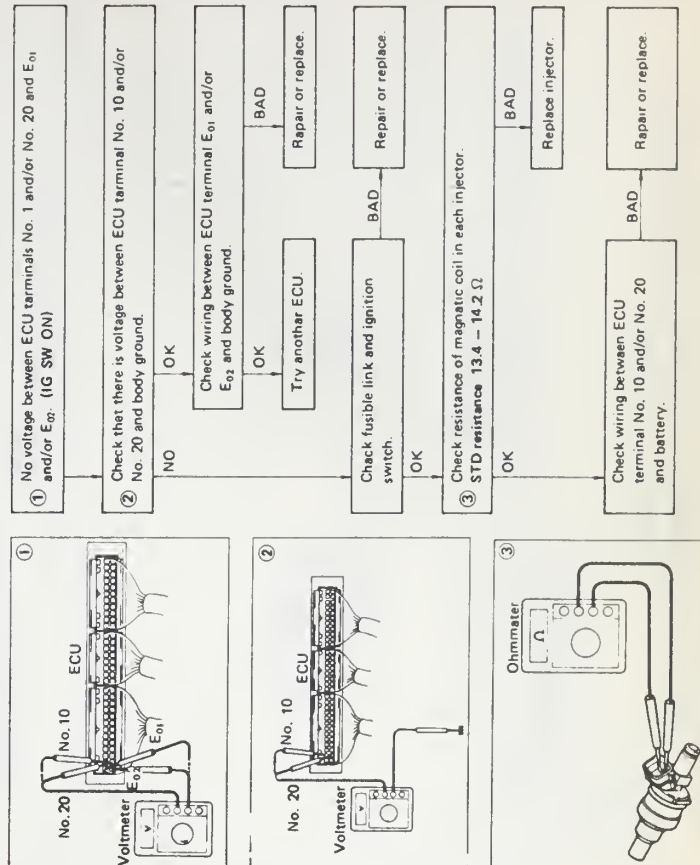


**ECU TEST NO.16 – 1989 TRUCK AND 4RUNNER WITH  
3VZ-E, AUTOMATIC TRANS OR C&C WITH  
MANUAL TRANS**

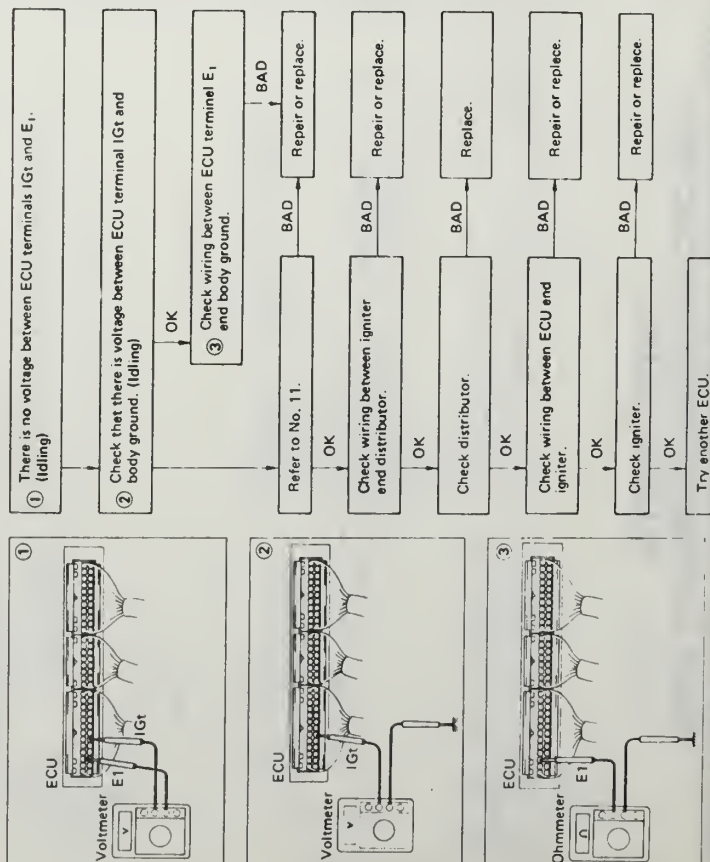
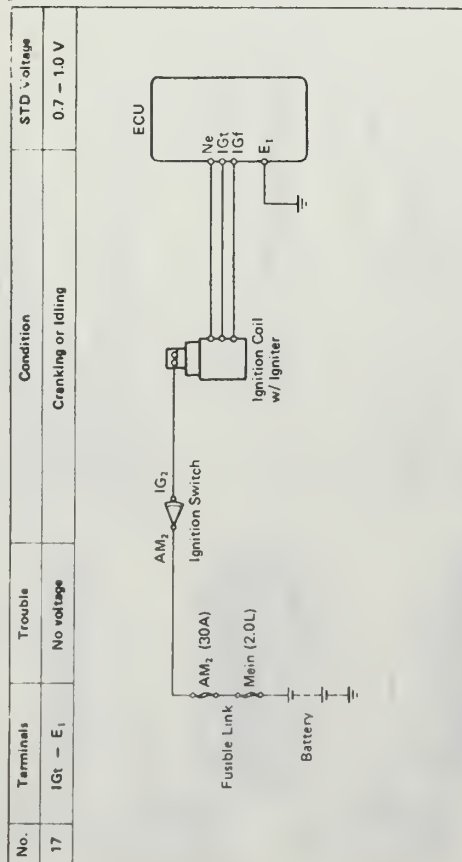
| No. | Terminals                                            | Trouble    | Condition          | STD Voltage |
|-----|------------------------------------------------------|------------|--------------------|-------------|
| 16  | No. 10 — E <sub>01</sub><br>No. 20 — E <sub>02</sub> | No voltage | Ignition switch ON | 10 — 14 V   |

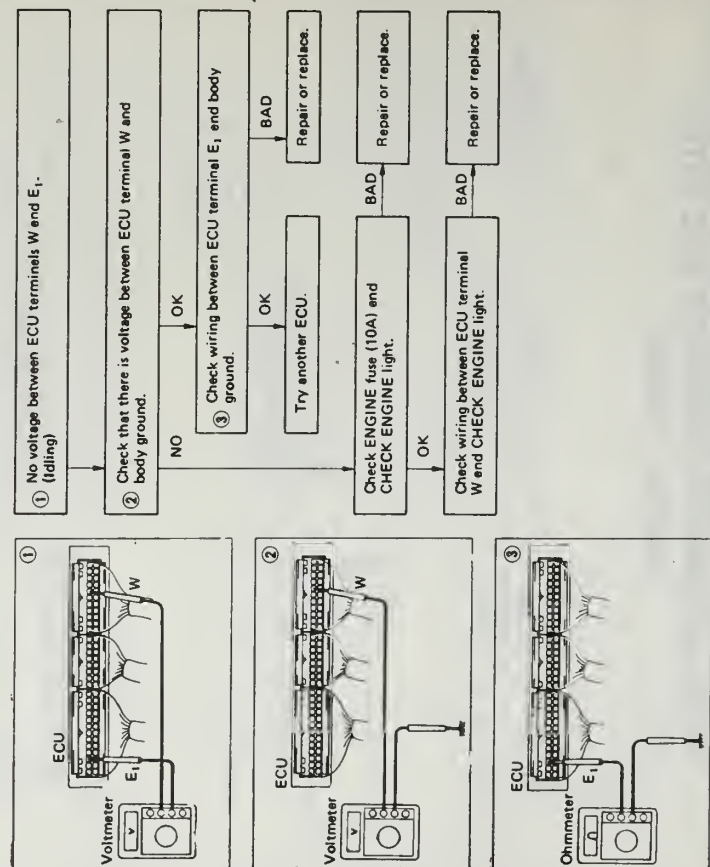
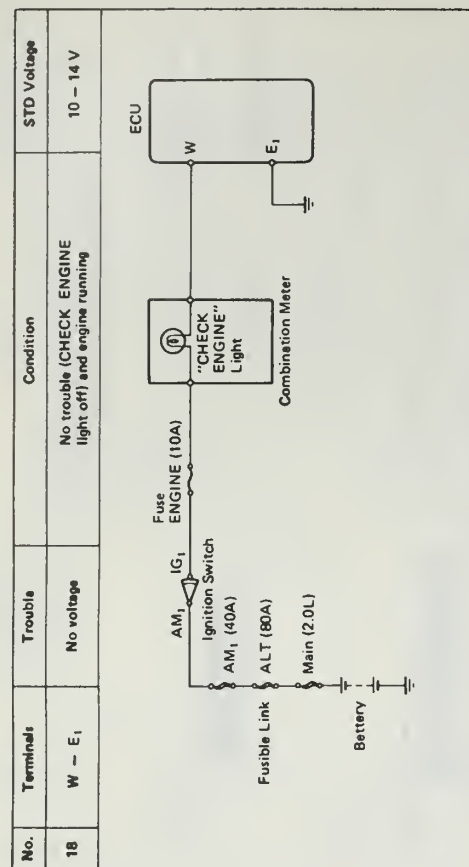
The diagram illustrates the electrical circuit for the ignition system when the ignition switch is turned ON. A battery provides power to a fusible link labeled 'Main (20L)' and an 'AM<sub>2</sub> (30A)' fuse. After the fuse, the circuit branches into two parallel paths. The first path goes through an 'Ignition Switch' to a coil labeled 'IG<sub>2</sub>'. The second path goes through an 'Injector' to the 'ECU' (Engine Control Unit). The ECU has three terminals: 'No. 10', 'No. 20', and 'E<sub>01</sub> (E<sub>02</sub>)'. All three terminals are connected to ground.



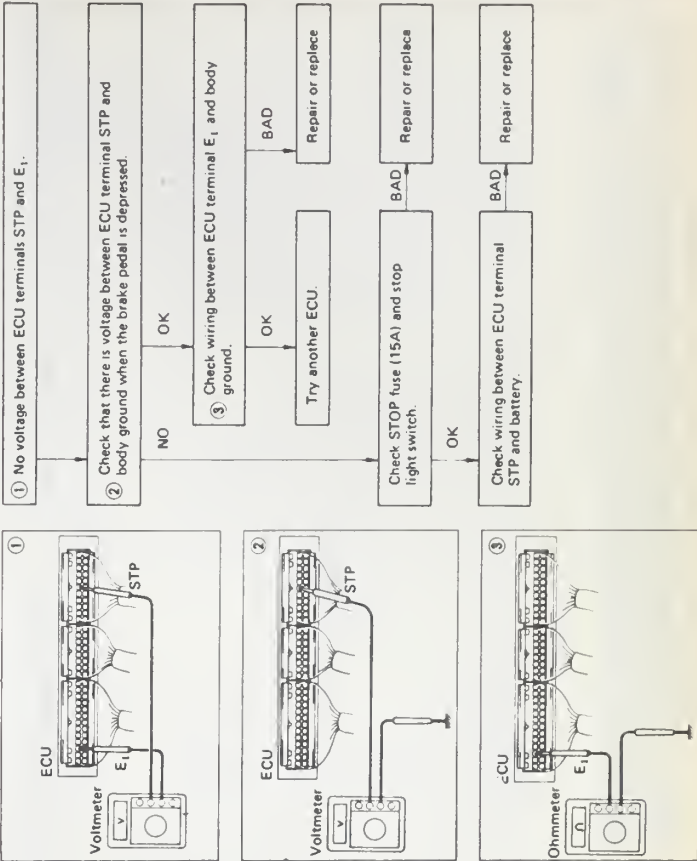
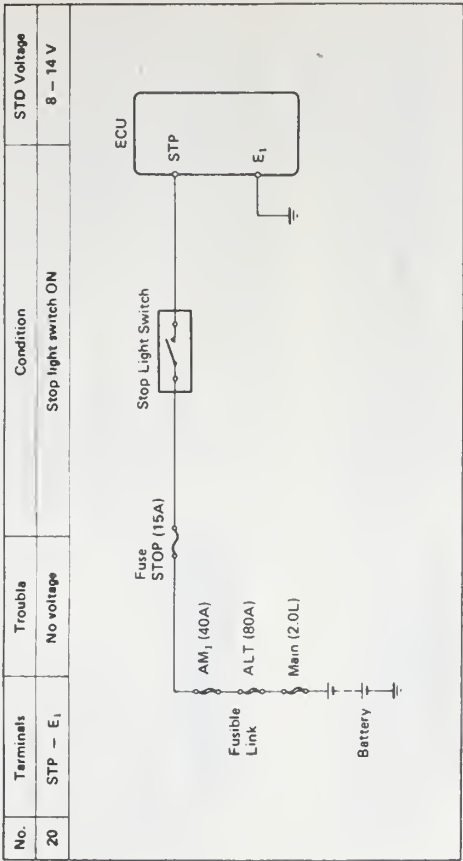
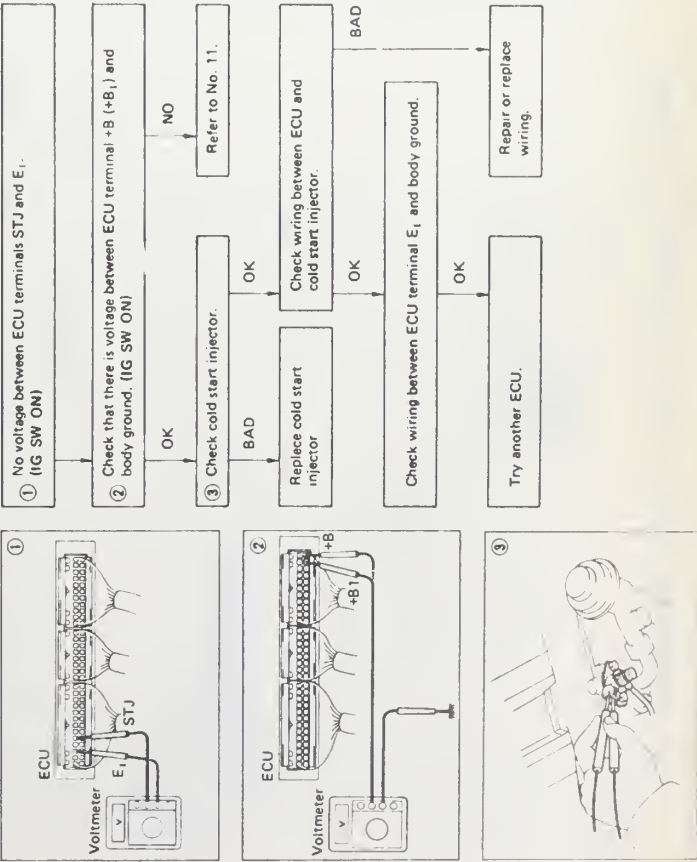
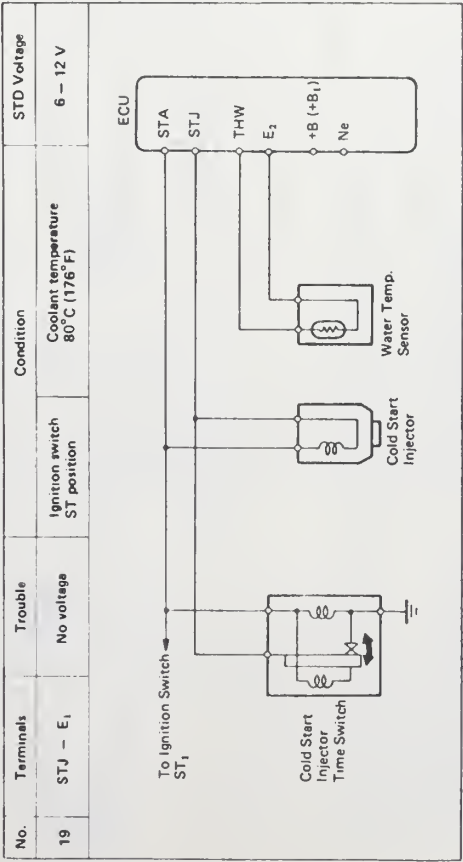
# ECU TEST NO.17 – 1989 TRUCK AND 4RUNNER WITH 3VZ-E, AUTOMATIC TRANS OR C&C WITH MANUAL TRANS



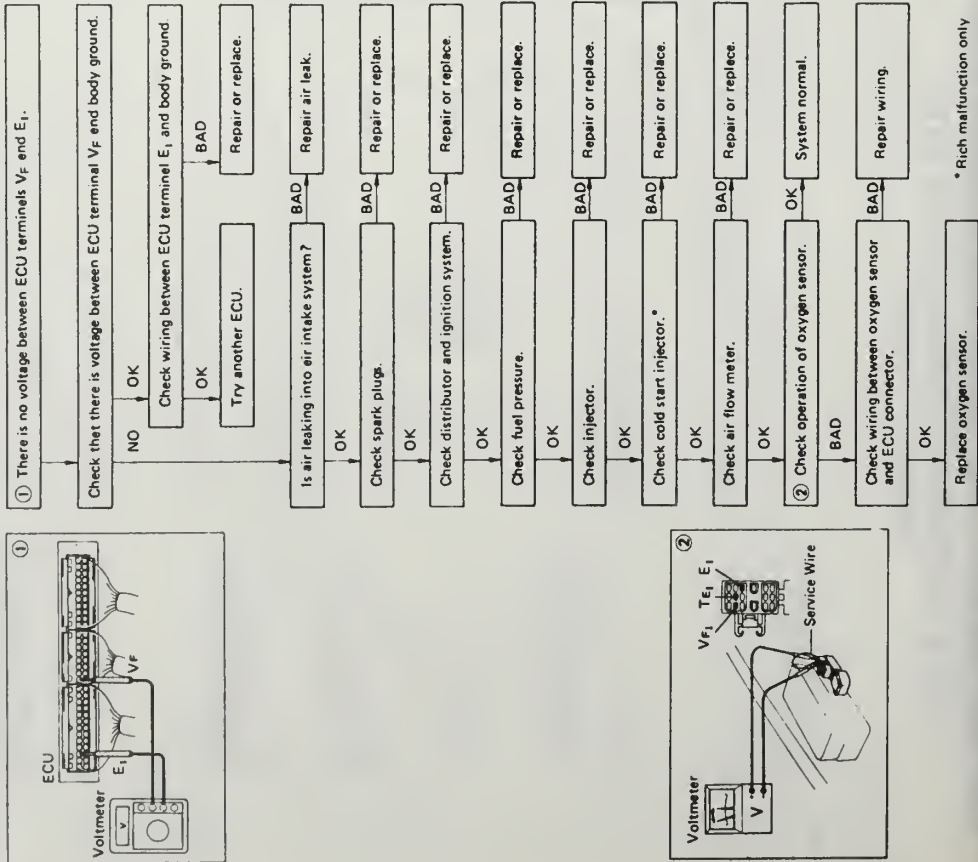
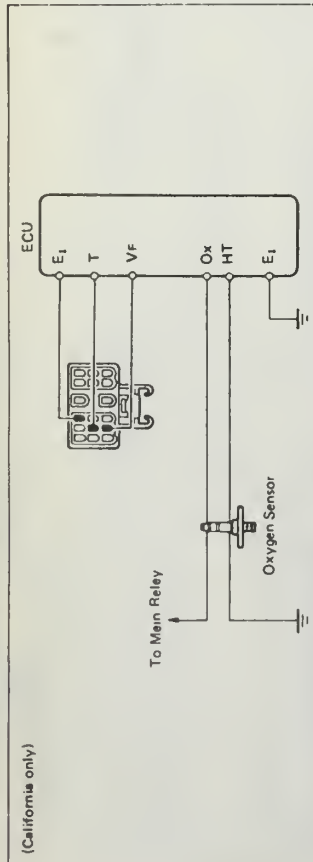
# ECU TEST NO.18 – 1989 TRUCK AND 4RUNNER WITH 3VZ-E, AUTOMATIC TRANS OR C&C WITH MANUAL TRANS





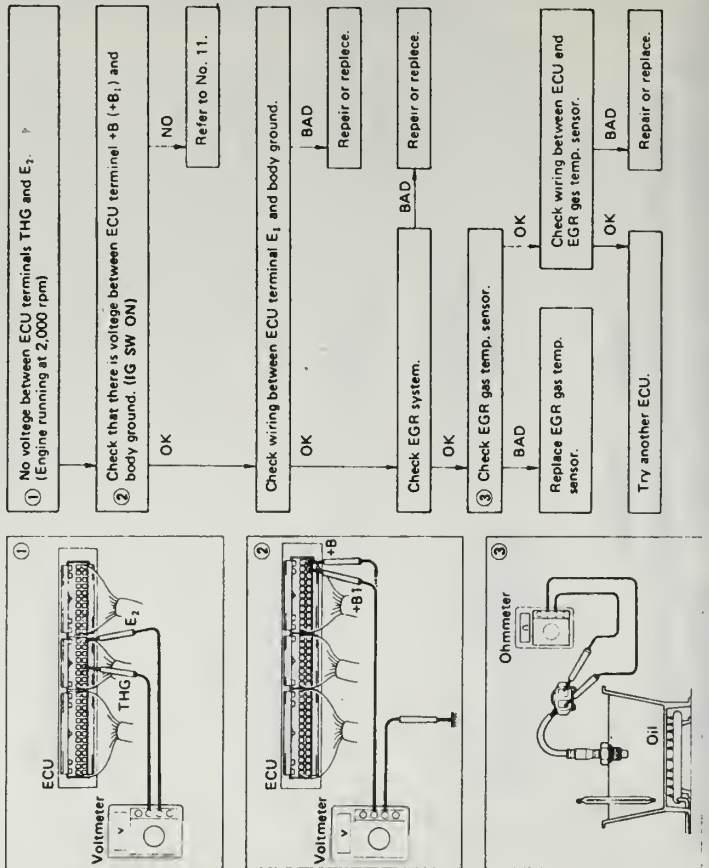
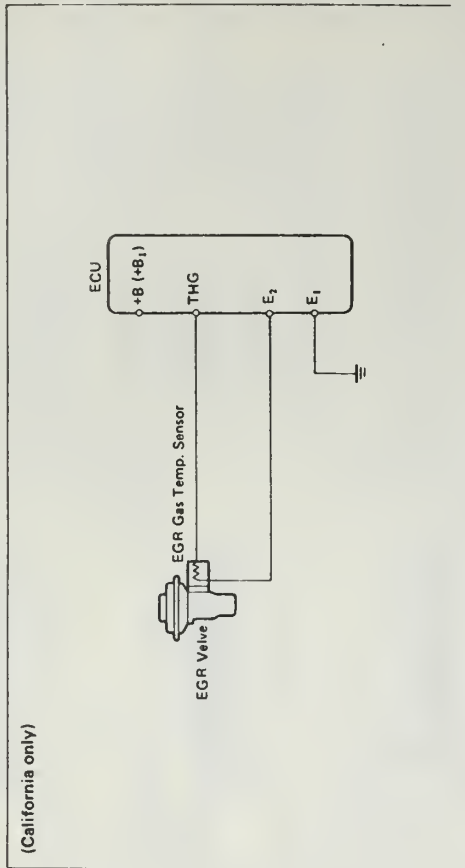


# OXYGEN SENSOR TEST – 1989 CALIFORNIA TRUCK AND 4RUNNER WITH 3VZ-E, AUTOMATIC TRANS

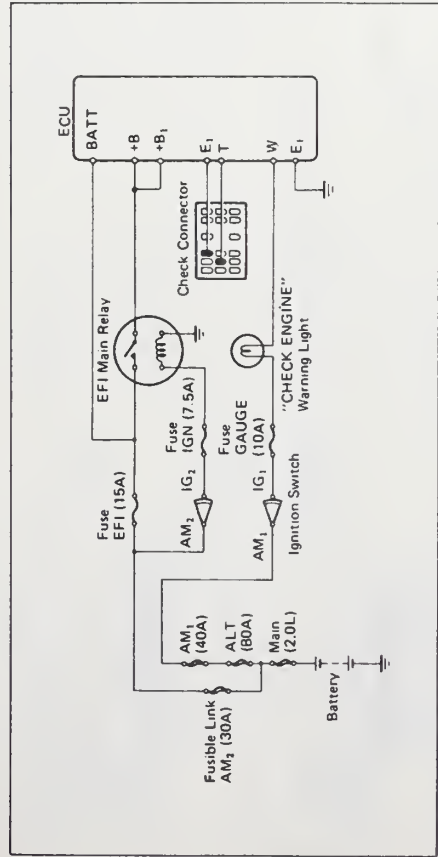


# 5 FUEL SYSTEM

## EGR GAS TEMPERATURE SENSOR – 1989 CALIFORNIA TRUCK AND 4RUNNER WITH 3VZ-E, AUTOMATIC TRANS OR C&C WITH MANUAL TRANS



TESTING THE ECU DIAGNOSTIC CIRCUIT –  
1990 TRUCK AND 4RUNNER WITH 3VZ-E



- Does CHECK ENG. light come on when ignition switch is at ON?  
YES → System Normal  
NO → Does CHECK ENG. light come on when ECU terminal W is grounded to the body?  
YES → Check wiring between ECU terminal E1 and body ground.  
OK → Try another ECU.  
BAD → Repair or replace  
Check bulb, fuse and wiring between ECU and ignition switch.  
BAD → Repair or replace
- Does CHECK ENG. light go OFF when engine is started?  
YES → System Normal  
NO → Check wiring between ECU and CHECK ENG. light.  
OK → Repair  
Is there diagnosis code output when check connector Te1 and E1 is connect circuited?  
YES → Try another ECU.  
NO → Does CHECK ENG. light go out after repair according to malfunction code?  
Further repair required.  
YES → Cancel out diagnostic code.  
NO → System OK

ECU CONNECTORS – 1990 TRUCK AND 4RUNNER WITH 3VZ-E, FEDERAL WITH MANUAL TRANS

| Symbol | Terminal name                   | Symbol | Terminal name            | Symbol | Terminal name     |
|--------|---------------------------------|--------|--------------------------|--------|-------------------|
| E01    | ENGINE GROUND                   | T      | CHECK CONNECTOR          | SPD    | SPEED METER       |
| E02    | ENGINE GROUND                   | G2     | DISTRIBUTOR              | W      | WARNING LIGHT     |
| No.10  | INJECTOR                        | VTA    | THROTTLE POSITION SENSOR | STP    | STOP LIGHT SWITCH |
| No.20  | INJECTOR                        | Ne     | DISTRIBUTOR              | AS     | VSV (for AS)      |
| STA    | IGNITION SWITCH                 | IDL    | THROTTLE POSITION SENSOR | THA    | AIR TEMP SENSOR   |
| IG1    | IGNITER                         | HT     | OXYGEN SENSOR HEATER     | KNK    | KNOCK SENSOR      |
| STJ    | COLD START INJECTOR             | EGR    | VSV (for EGR)            | Vs     | AIR FLOW METER    |
| E1     | ENGINE GROUND                   | IGI    | IGNITER                  | *1 4WO | 4WO SWITCH        |
| *1 THG | EGR GAS TEMP SENSOR             | THW    | WATER TEMP SENSOR        | Vc     | AIR FLOW METER    |
| FPU    | VSV (for Fuel pressure control) | E2     | SENSOR EARTH             | TSW    | WATER TEMP SWITCH |
| *ACV-  | VSV (for A/C)                   | Dx     | OXYGEN SENSOR            | BATT   | BATTERY +B        |
| G      | DISTRIBUTOR                     | E3     | SENSOR EARTH             | +B     | MAIN RELAY        |
| VF     | CHECK CONNECTOR                 | A/C    | A/C MAGNETIC SWITCH      | +B1    | MAIN RELAY        |
| G1     | DISTRIBUTOR                     |        |                          |        |                   |

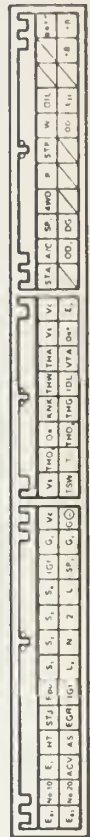
\*1 : California only    \*2 : 4WD only



ECU CONNECTORS – 1990 TRUCK AND 4RUNNER WITH 3VZ-E EXCEPT FEDERAL WITH MANUAL TRANS

| Symbol | Terminal name                   | Symbol | Terminal name            | Symbol | Terminal name              |
|--------|---------------------------------|--------|--------------------------|--------|----------------------------|
| E01    | ENGINE GROUND                   | *1 L   | NEUTRAL START SWITCH     | V1     | AIR FLOW METER             |
| E02    | ENGINE GROUND                   | IG1    | IGNITER                  | *4 O+  | OXYGEN SENSOR              |
| No.10  | INJECTOR                        | *1 SP2 | SPEED SENSOR             | Vc     | AIR FLOW METER             |
| E1     | ENGINE GROUND                   | G1     | DISTRIBUTOR              | E2     | SENSOR GROUND              |
| ACV    | VSV (for A/C)                   | Ne     | DISTRIBUTOR              | STA    | STARTER SWITCH             |
| HT     | OXYGEN SENSOR HEATER            | G      | DISTRIBUTOR              | A/C    | COMPRESSOR SWITCH          |
| AS     | VSV (for AS)                    | VF     | CHECK CONNECTOR          | *1001  | CRUISE CONTROL COMPUTER    |
| STJ    | COLD START INJECTOR             | TSW    | WATER TEMP SWITCH        | SP1    | SPEED SENSOR               |
| EGR    | VSV (for EGR)                   | *THO1  | TIM OIL TEMP SENSOR      | *1 DG  | CHECK CONNECTOR            |
| Fpu    | VSV (for Fuel pressure control) | T1     | CHECK CONNECTOR          | *24WD  | 4WD SWITCH                 |
| IG1    | IGNITER                         | O+     | OXYGEN SENSOR            | *1 P   | PATTERN SELECT SWITCH      |
| *1 S1  | ECT SOLENOID                    | *THO2  | TIM OIL TEMP SENSOR      | STP    | STOP LIGHT SWITCH          |
| *2 L4  | TRANSFER POSITION SWITCH        | KNK    | KNOCK SENSOR             | W      | CHECK ENGINE WARNING LIGHT |
| *1 S2  | ECT SOLENOID                    | *1 THG | EGR GAS TEMP SENSOR      | *1002  | CRUISE CONTROL COMPUTER    |
| *1 N   | NEUTRAL START SWITCH            | THW    | WATER TEMP SENSOR        | *2 OIL | AIR OIL TEMP WARNING LIGHT |
| *1 S3  | ECT SOLENOID                    | IDL    | THROTTLE POSITION SENSOR | E3     | SENSOR GROUND              |
| *1 2   | NEUTRAL START SWITCH            | THA    | AIR TEMP SENSOR          | +B1    | MAIN RELAY                 |
| *2 S4  | ECT SOLENOID                    | VTA    | THROTTLE POSITION SENSOR | BATT   | BATTERY +B                 |
|        |                                 |        |                          | +B     | MAIN RELAY                 |

\*1 : A/T only    \*2 : 4WD A/T only    \*3 : California only    \*4 : California 2WD only





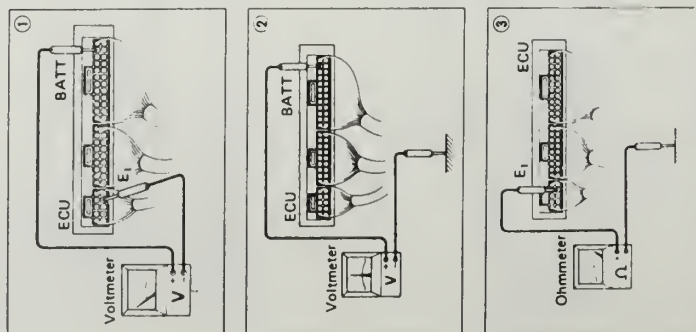
● BATT = E<sub>1</sub>

```

graph TD
 Start([Start]) --> Step1[① There is no voltage between ECU terminals BATT and E1.]
 Step1 --> Step2[② Check that there is voltage between ECU terminal BATT and body ground.]
 Step2 -- NO --> Step3[③ Check wiring between ECU terminal E1 and body ground.]
 Step2 -- OK --> Step4[Check fuse and fusible link.]
 Step3 -- OK --> Step4
 Step3 -- BAD --> Step5[Repair or replace.]
 Step4 -- OK --> Step6[Check wiring between fuse and ECU.]
 Step4 -- BAD --> Step7[Replace.]
 Step6 -- OK --> Step8[Repair or replace.]
 Step6 -- BAD --> Step7
 Step7 --> End([End])

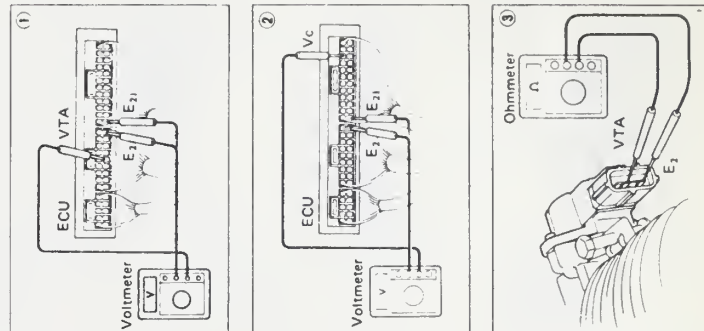
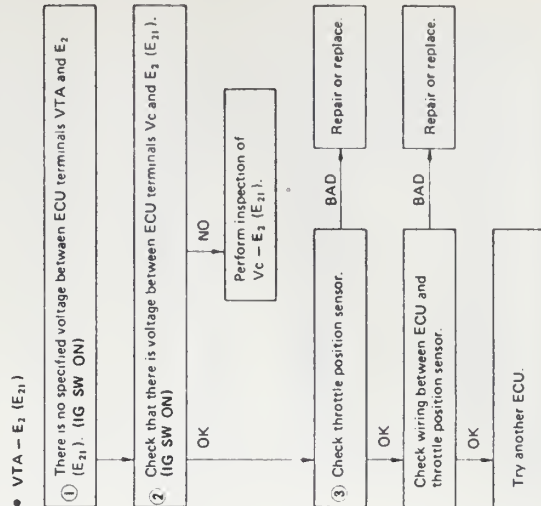
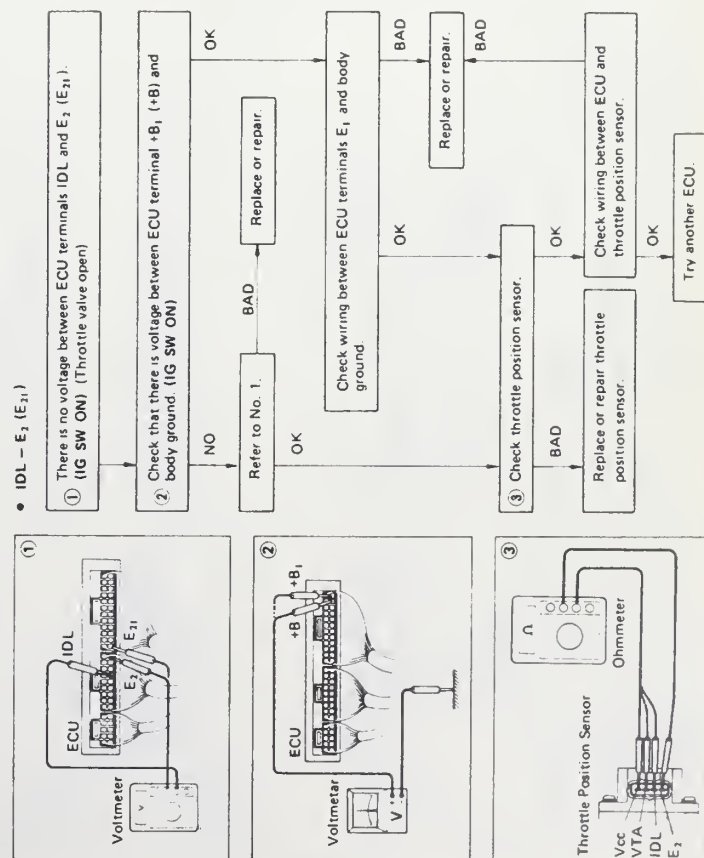
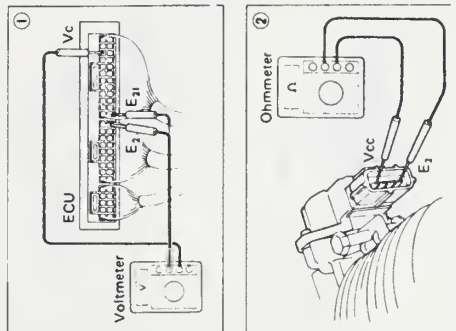
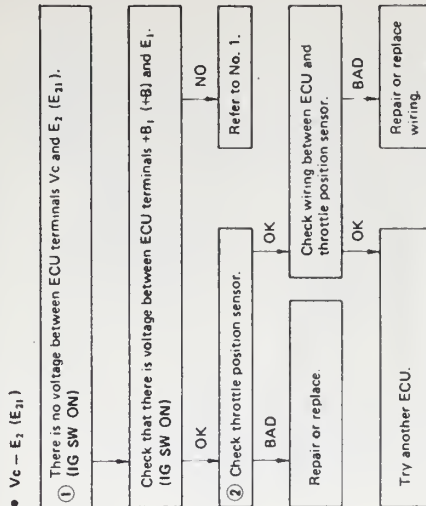
```

The flowchart outlines the troubleshooting steps for ECU terminal E<sub>1</sub> and BATT voltage. It starts with a check for voltage between ECU terminals BATT and E<sub>1</sub>. If there is no voltage, the next step is to check for voltage between ECU terminal BATT and body ground. If this check fails (NO), the wiring between ECU terminal E<sub>1</sub> and body ground is checked. If this check is OK, the process moves to checking the fuse and fusible link. If the fuse check fails (BAD), the fuse is replaced. If the fuse check is OK, the wiring between the fuse and the ECU is checked. If this check fails (BAD), the fuse is replaced. If the wiring check is OK, the fuse and fusible link are repaired or replaced. If the initial check for voltage between BATT and E<sub>1</sub> is OK, the process moves directly to checking the fuse and fusible link.



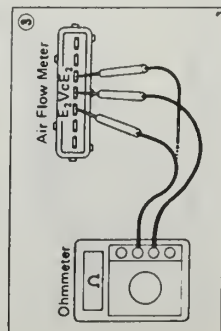
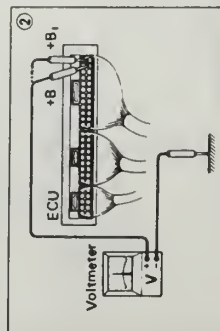
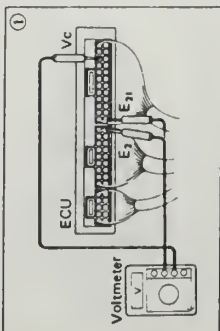
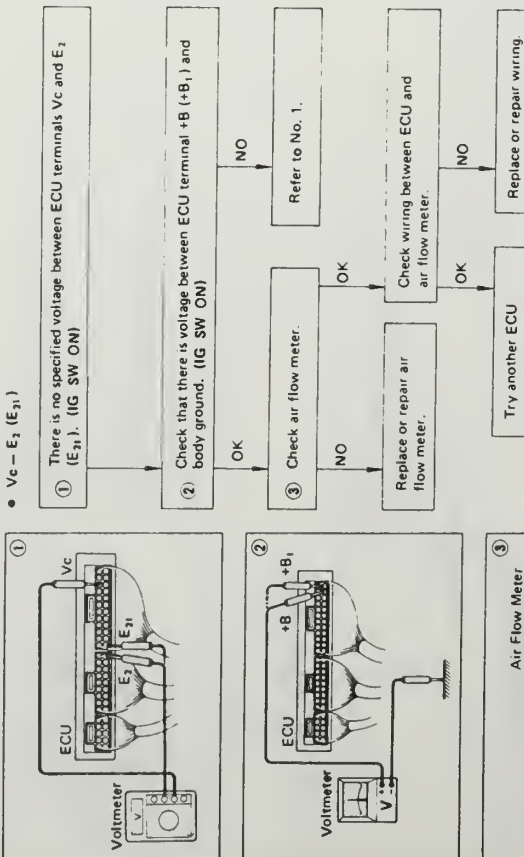
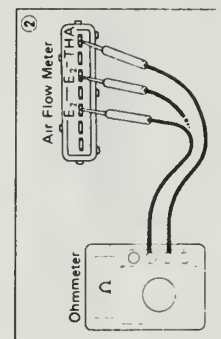
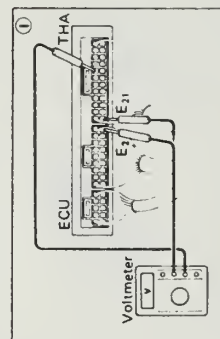
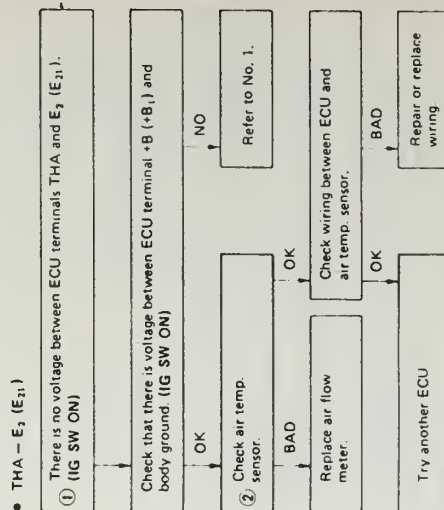
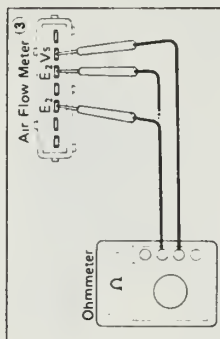
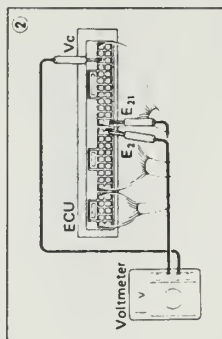
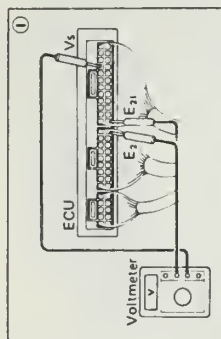
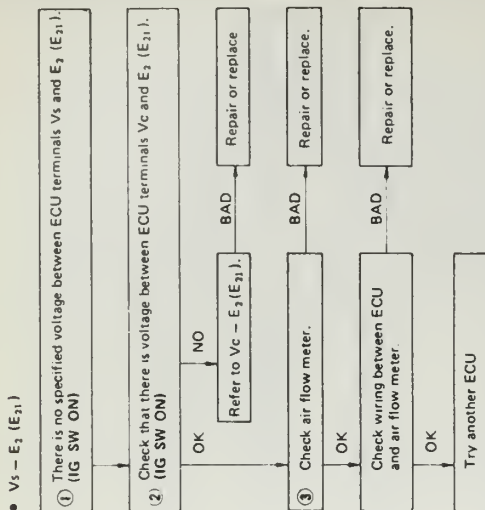
| No. | Terminals                               | Trouble    | Condition                 | STD Voltage |
|-----|-----------------------------------------|------------|---------------------------|-------------|
| 2   | IDL → E <sub>2</sub> (E <sub>21</sub> ) | No voltage | Ignition switch ON        | 8 - 14 V    |
|     | Vc → E <sub>2</sub> (E <sub>21</sub> )  |            |                           | 4 - 6 V     |
|     | VTA → E <sub>2</sub> (E <sub>21</sub> ) |            |                           | 0.1 - 1.0 V |
|     |                                         |            | Throttle valve fully open | 3 - 5 V     |

Throttle Position Sensor

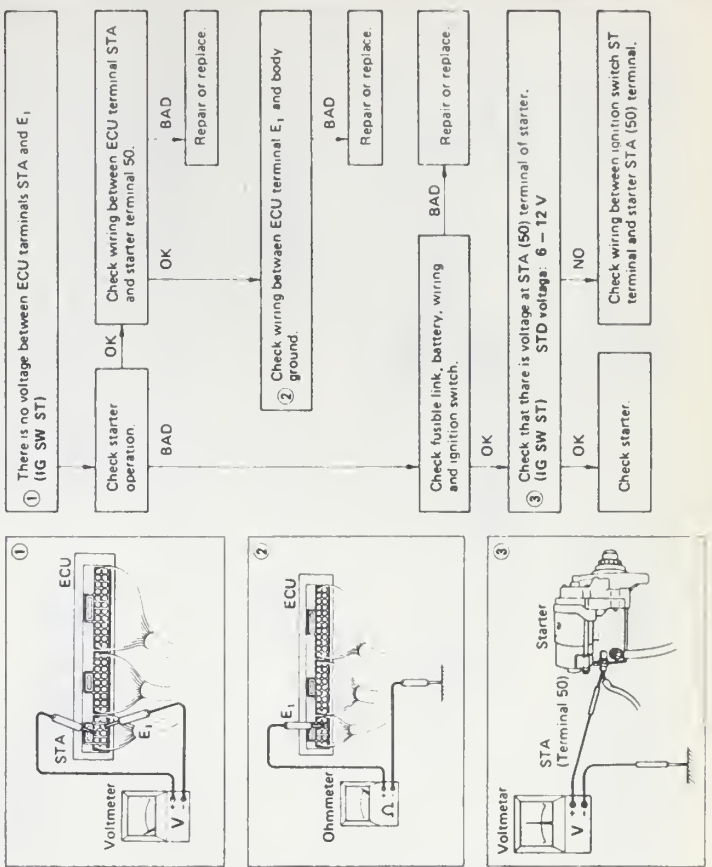
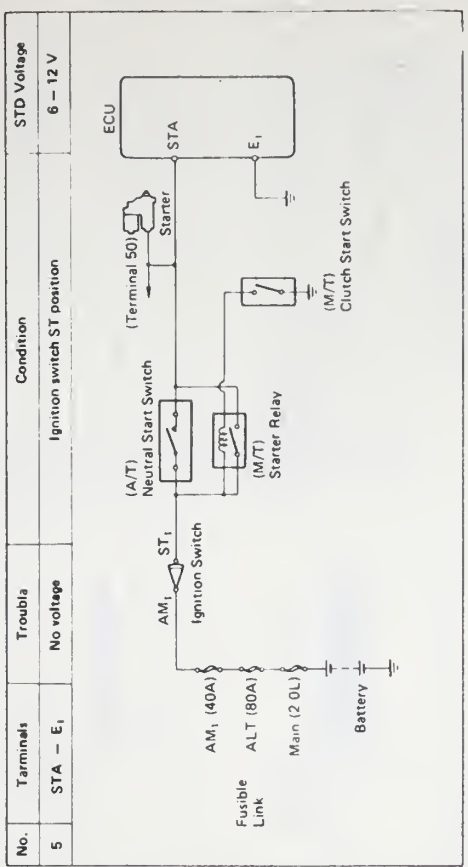
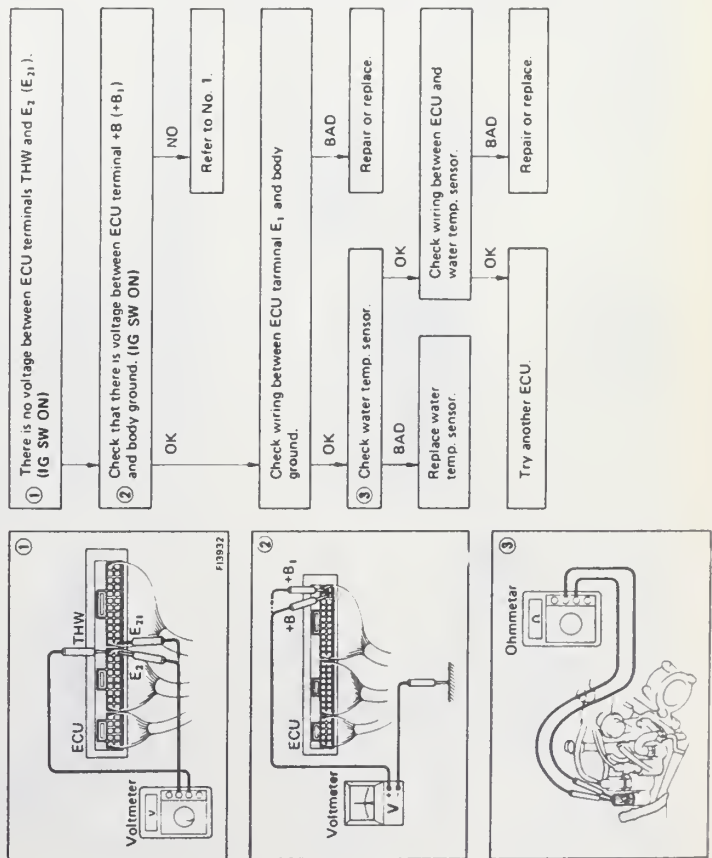
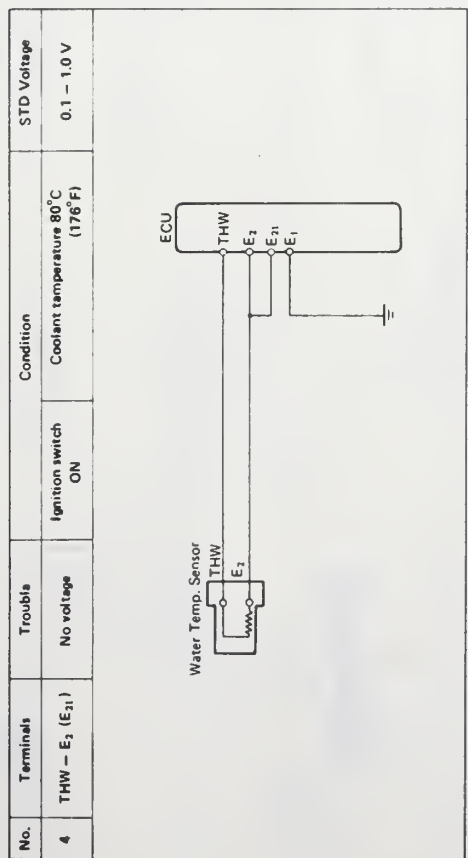


# 5 FUEL SYSTEM

| No. | Terminal                 | Trouble    | Condition                          | STD Voltage |
|-----|--------------------------|------------|------------------------------------|-------------|
| 3   | $V_c - E_2$ ( $E_{31}$ ) | No voltage | Ignition SW ON                     | 4 - 6 V     |
|     | $V_A - E_2$ ( $E_{31}$ ) |            | Measuring plate fully closed       | 3.7 - 4.3 V |
|     | $THA - E_2$ ( $E_{31}$ ) |            | Measuring plate fully open         | 0.2 - 0.5 V |
|     |                          |            | Idling                             | 2.3 - 2.8 V |
|     |                          |            | Intake air temperature 20°C (68°F) | 1 - 3 V     |

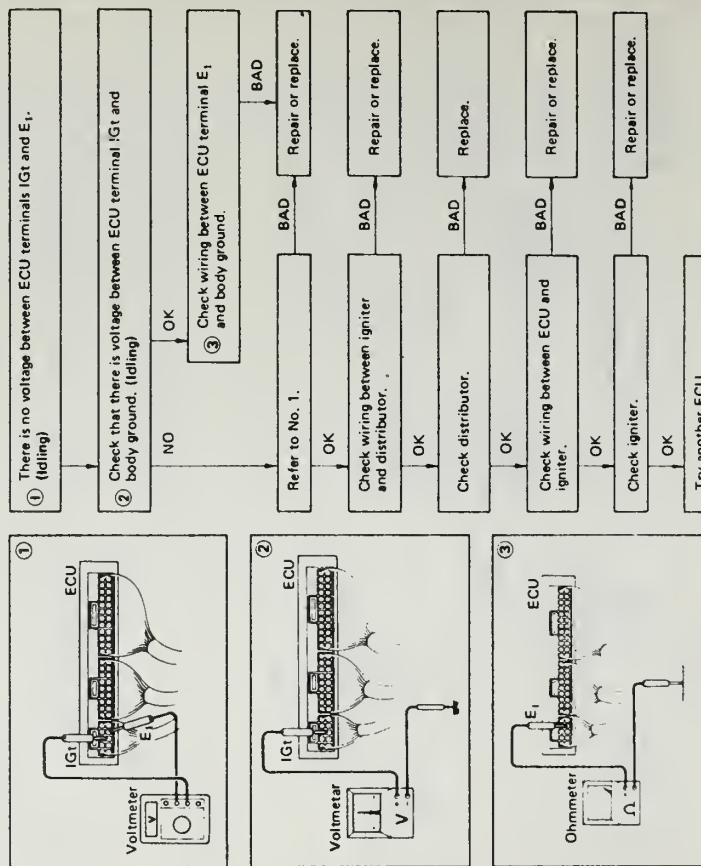
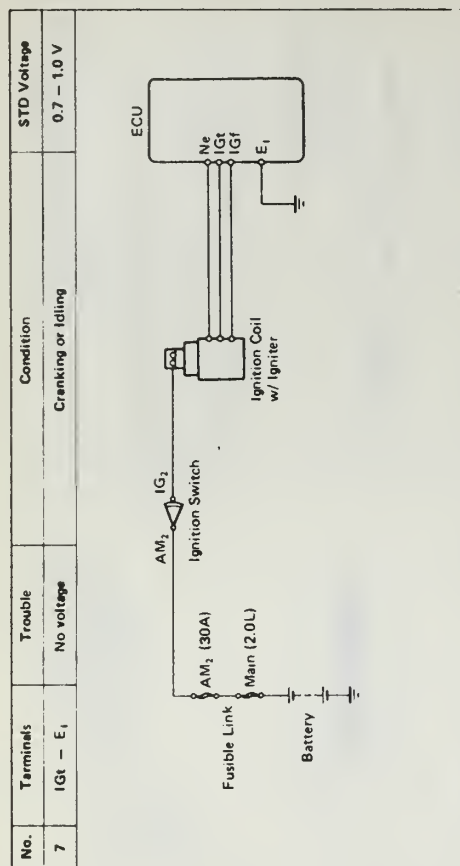
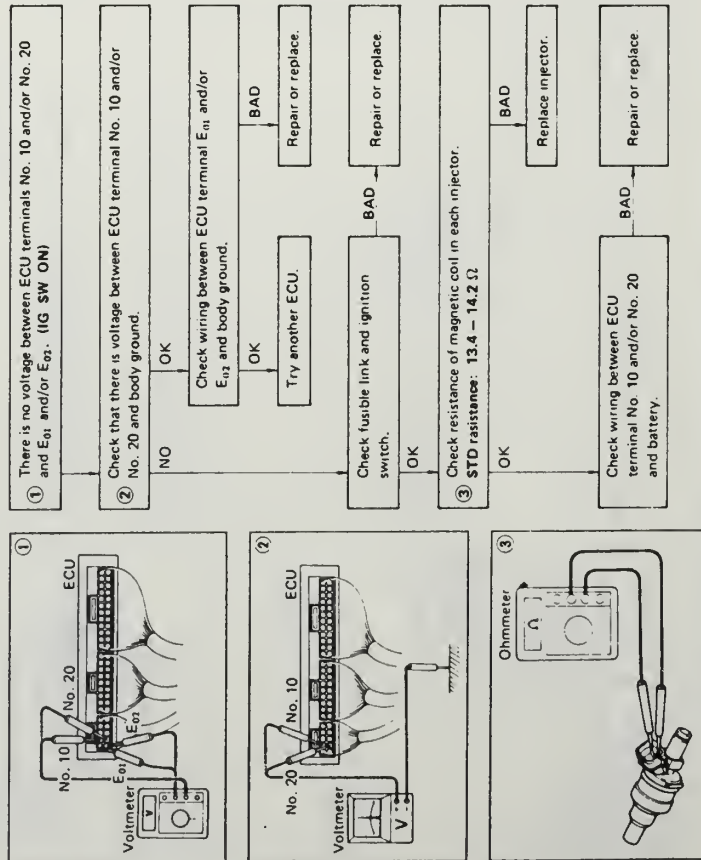
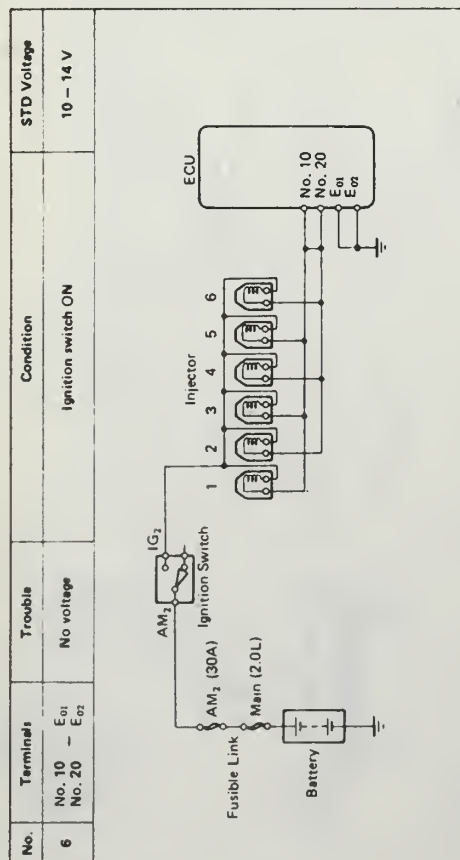
  






# ECU TEST NO.6 — 1990 TRUCK AND 4RUNNER WITH 3VZ-E, FEDERAL WITH MANUAL TRANS

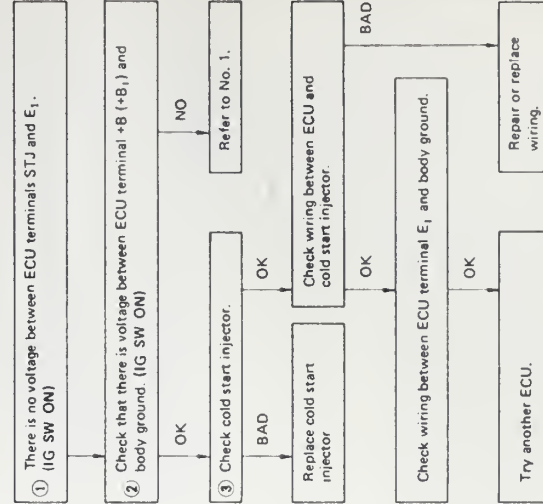
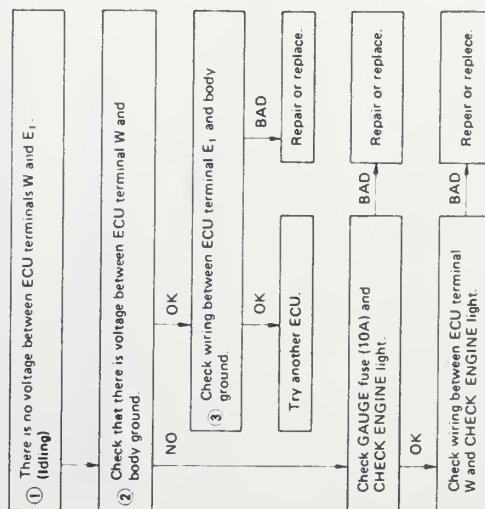
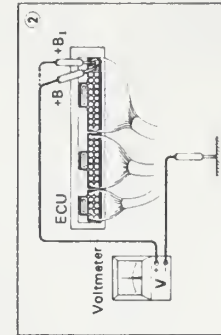
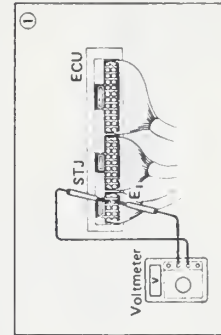
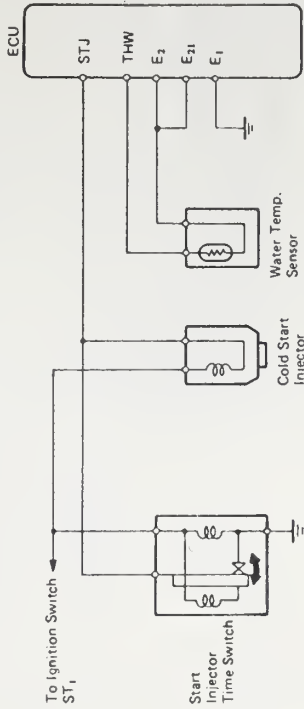
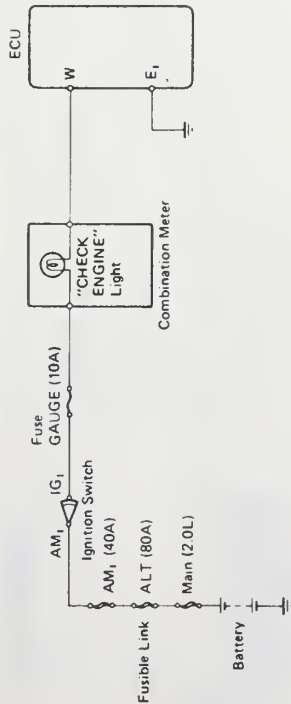
# ECU TEST NO.7 — 1990 TRUCK AND 4RUNNER WITH 3VZ-E, FEDERAL WITH MANUAL TRANS



**ECU TEST NO.8 - 1990 TRUCK AND 4RUNNER WITH  
3VZ-E, FEDERAL WITH MANUAL TRANS**

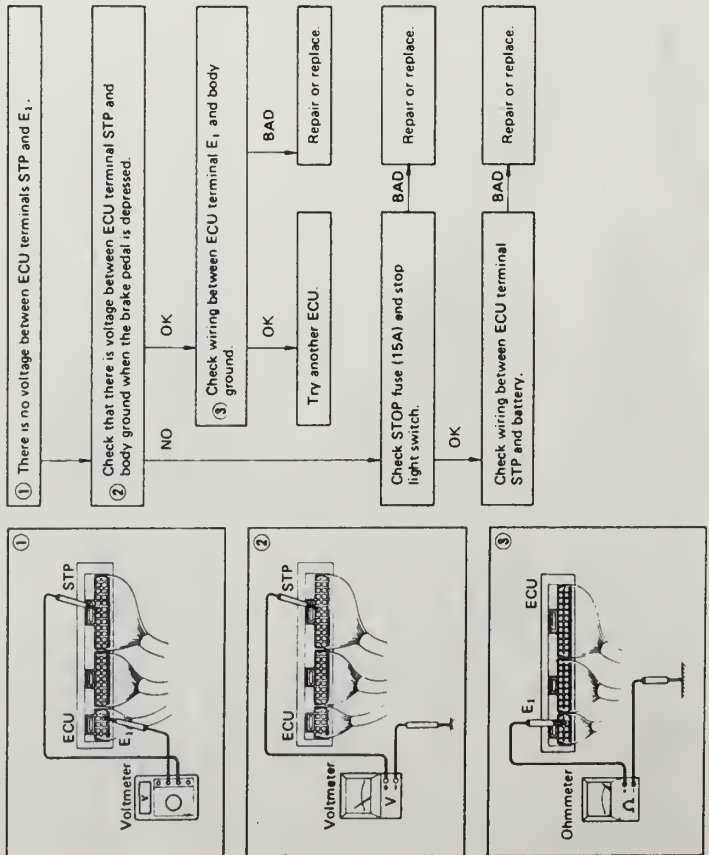
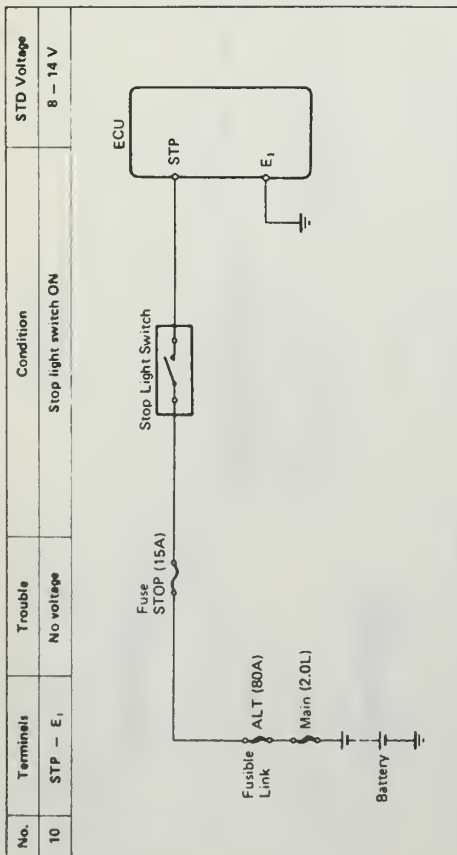
| No. | Terminals            | Trouble    | Condition                           | STD Voltage |
|-----|----------------------|------------|-------------------------------------|-------------|
| 9   | STJ - E <sub>1</sub> | No voltage | Coolant temperature<br>80°C (176°F) | 6 - 12 V    |

The diagram illustrates the electrical circuit for the Coolant Temperature sensor. The ECU (Engine Control Unit) is connected to several terminals: STJ, THW, E<sub>2</sub>, E<sub>21</sub>, and E<sub>1</sub>. The STJ terminal is connected to the Ignition Switch (ST<sub>1</sub>) and the Cold Start Injector. The THW terminal is connected to the Water Temp. Sensor. The E<sub>2</sub>, E<sub>21</sub>, and E<sub>1</sub> terminals are connected to a common ground point. The Ignition Switch (ST<sub>1</sub>) is connected to the Start Injector Time Switch. The Cold Start Injector is connected to the Start Injector Time Switch. The Water Temp. Sensor is connected to the ECU terminal THW.

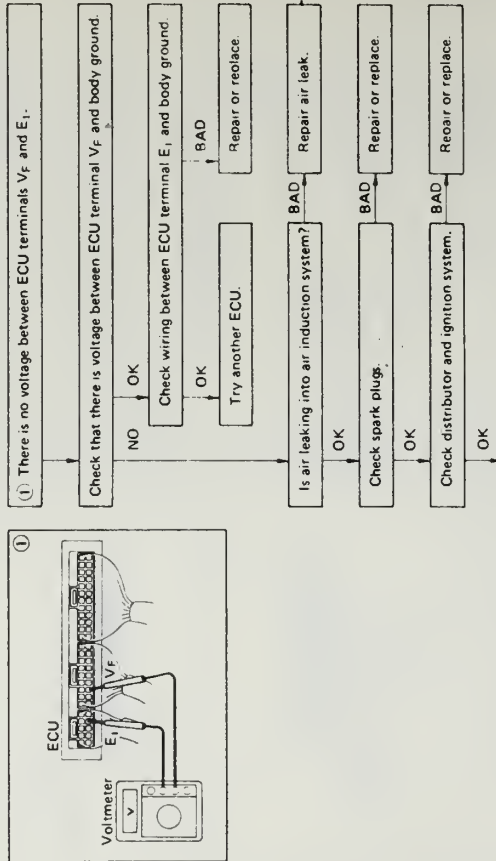
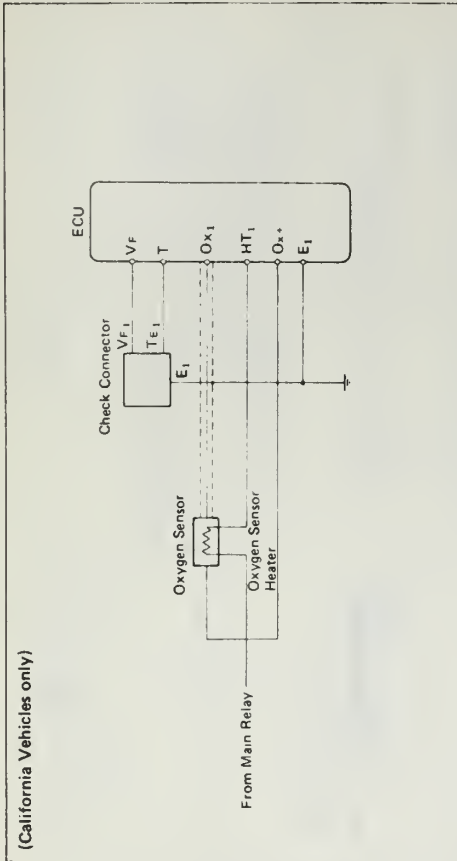




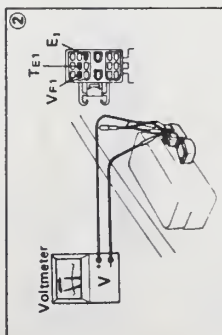
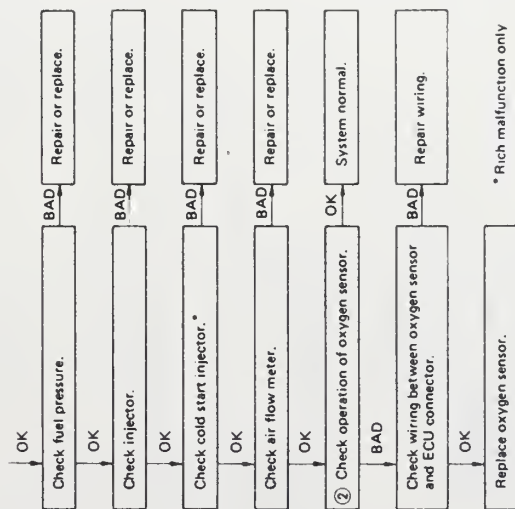
# ECU TEST NO.10 – 1990 TRUCK AND 4RUNNER WITH 3VZ-E, FEDERAL WITH MANUAL TRANS



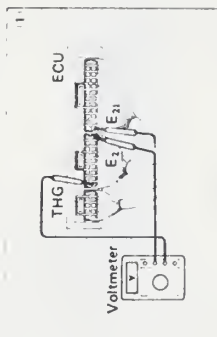
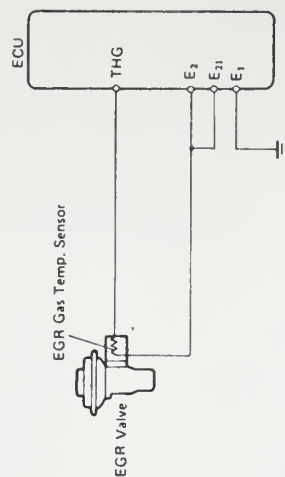
# OXYGEN SENSOR AND HEATER TEST – 1990 TRUCK AND 4RUNNER WITH 3VZ-E, CALIFORNIA WITH MANUAL TRANS



CONTINUED



(California Vehicles only)



① There is no voltage between ECU terminals THG and E<sub>1</sub> (E<sub>31</sub>).  
(Engine running at 2,000 rpm)

② Check that there is voltage between ECU terminal +B (+B<sub>1</sub>) and body ground. (IG SW ON)

OK  
NO  
Refer to No. 1.

Check wiring between ECU terminal E<sub>1</sub> and body ground.

OK  
BAD  
Repair or replace.

Check EGR system.

BAD  
Repair or replace.

③ Check EGR gas temp. sensor.

BAD

Replace EGR gas temp. sensor.

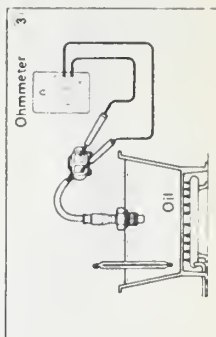
OK

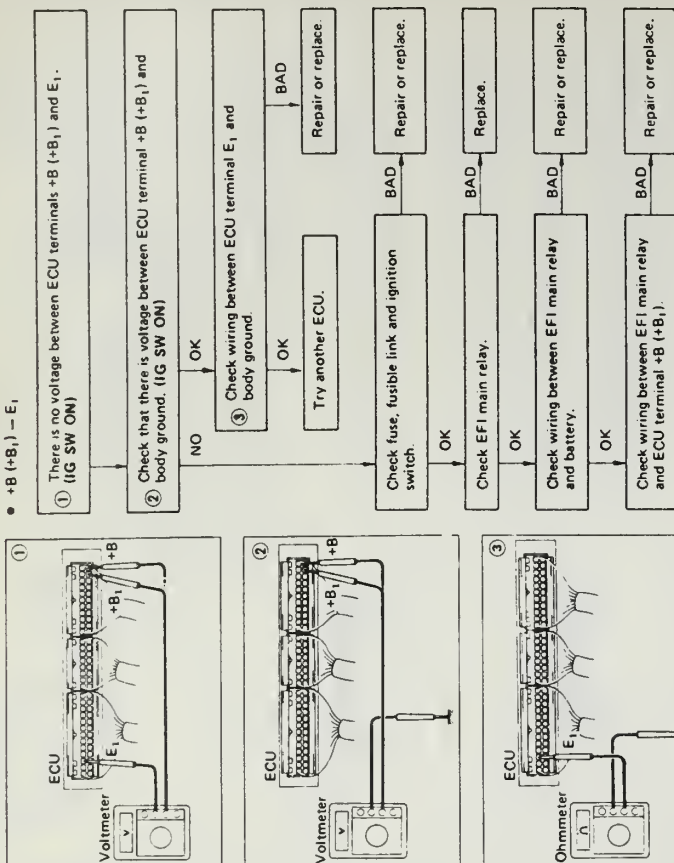
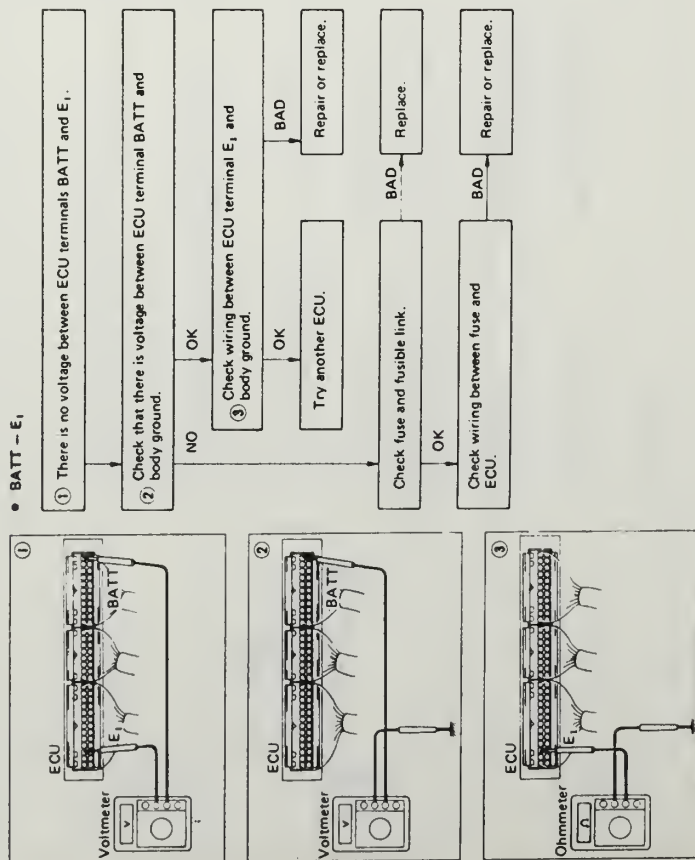
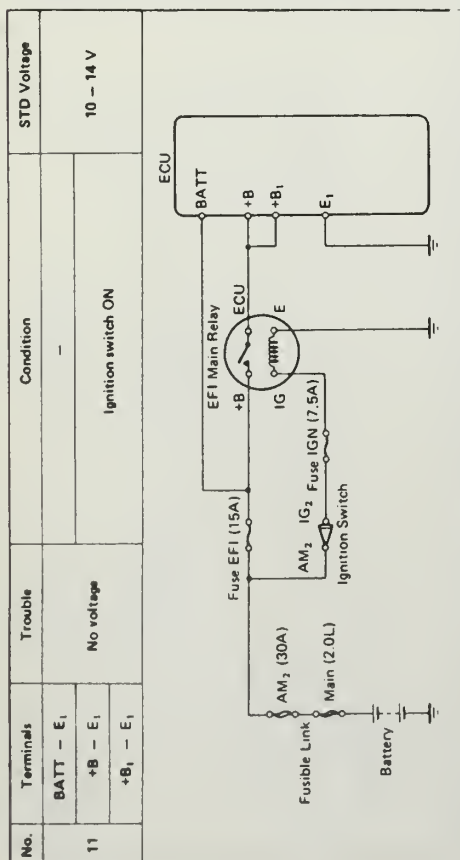
Check wiring between ECU and EGR gas temp. sensor.

OK

Try another ECU.

BAD  
Repair or replace.



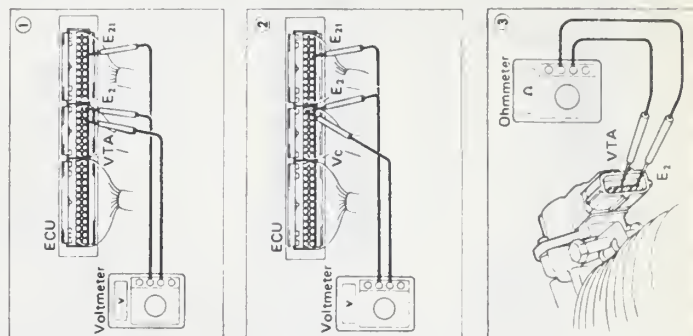
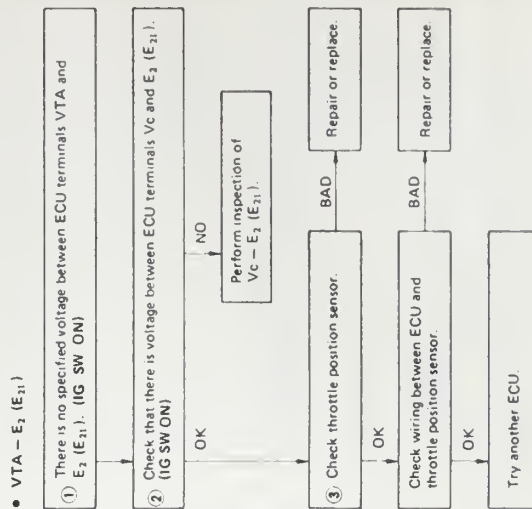
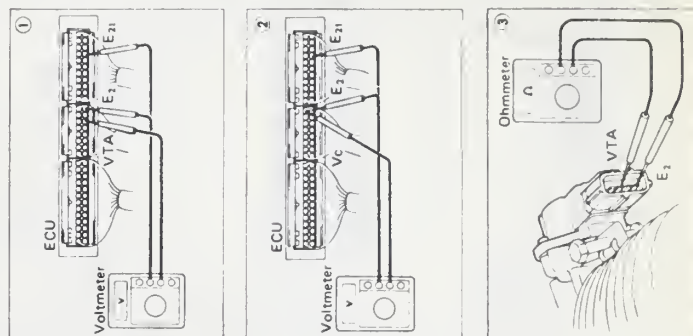
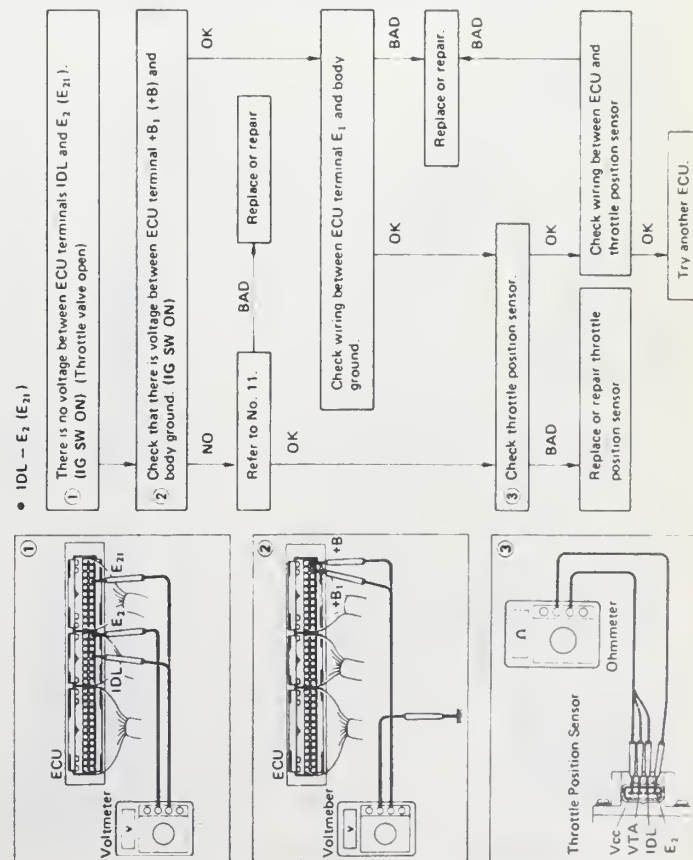
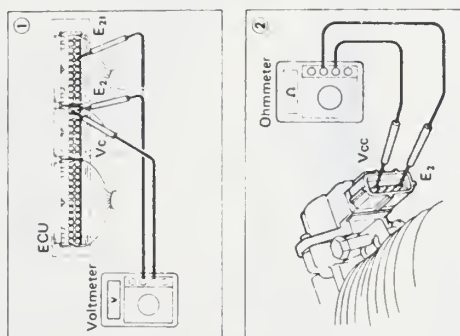
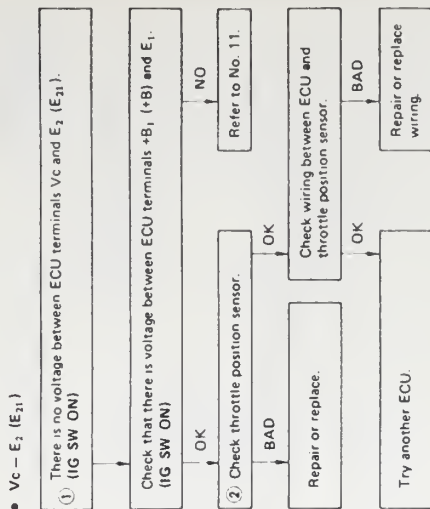




| No. | Terminals                               | Trouble    | Condition                   | STD Voltage |
|-----|-----------------------------------------|------------|-----------------------------|-------------|
| 12  | IDL - E <sub>3</sub> (E <sub>31</sub> ) | No voltage | Throttle valve open         | 8 - 14 V    |
|     | Vc - E <sub>3</sub> (E <sub>31</sub> )  |            | Throttle valve fully closed | 4 - 6 V     |
|     | VTA - E <sub>3</sub> (E <sub>31</sub> ) |            | Throttle valve fully open   | 0.1 - 1.0 V |
|     |                                         |            | Throttle valve fully open   | 3 - 5 V     |

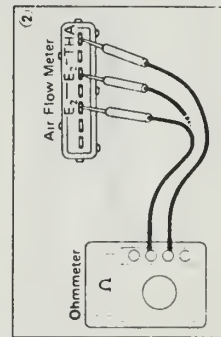
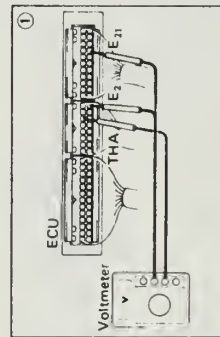
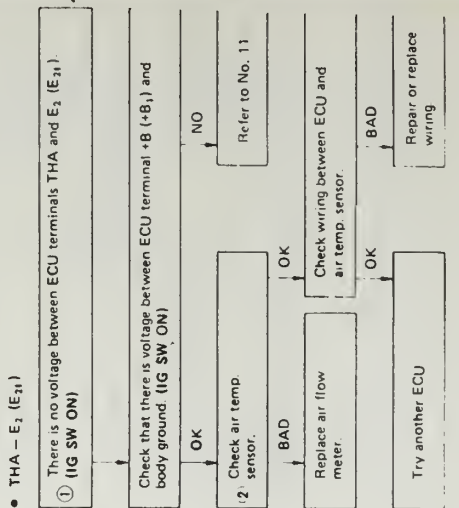
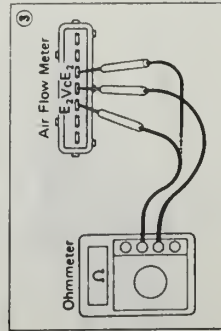
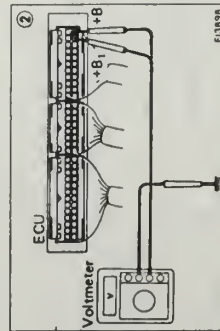
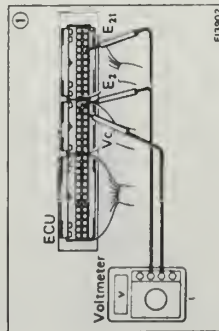
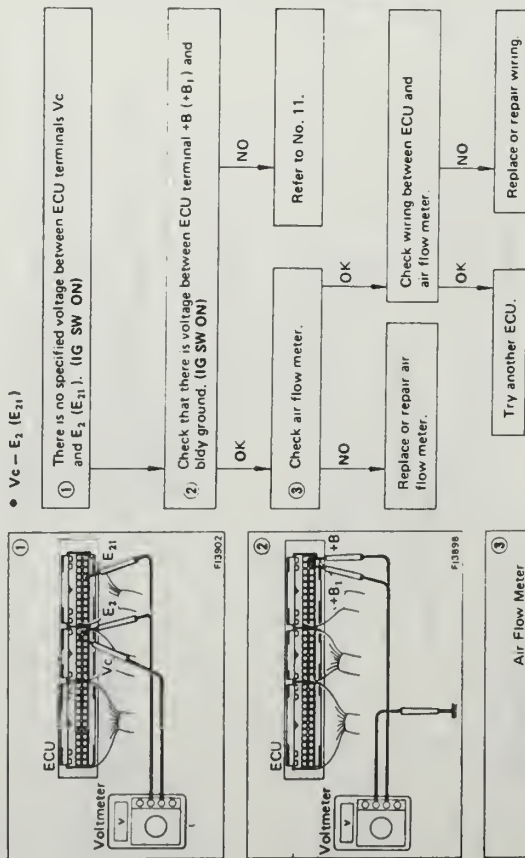
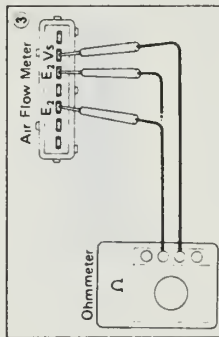
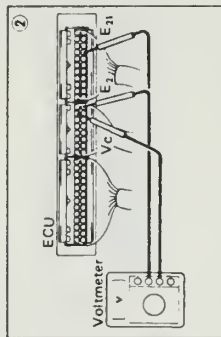
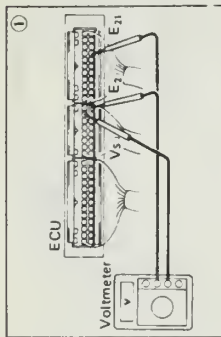
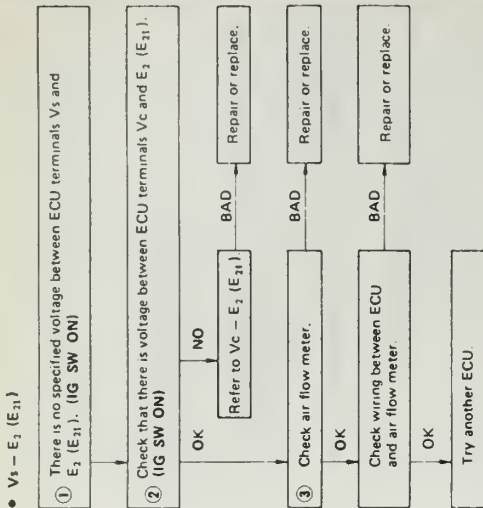
Throttle Position Sensor



# 5 FUEL SYSTEM

| No. | Terminal                 | Trouble    | Condition                    | STD Voltage |
|-----|--------------------------|------------|------------------------------|-------------|
| 13  | $V_c - E_2$ ( $E_{21}$ ) | No voltage | Ignition SW ON               | 4 - 6 V     |
|     | $V_1 - E_2$ ( $E_{21}$ ) |            | Measuring plate fully closed | 3.7 - 4.3 V |
|     |                          |            | Measuring plate fully open   | 0.2 - 0.5 V |
|     | $THA - E_2$ ( $E_{21}$ ) |            | Idling                       | 2.3 - 2.8 V |
|     |                          |            | IG SW ON                     | 1 - 3 V     |

Intake air temperature 20°C (68°F)



| No. | Terminals                               | Trouble    | Condition                                              | STD Voltage |
|-----|-----------------------------------------|------------|--------------------------------------------------------|-------------|
| 14  | THW - E <sub>2</sub> (E <sub>21</sub> ) | No voltage | Ignition switch ON<br>Coolant temperature 80°C (176°F) | 0.1 - 1.0 V |

Water Temp. Sensor

ECU

THW

E<sub>2</sub>

E<sub>21</sub>

E<sub>1</sub>

1

Voltmeter

ECU

THW

E<sub>21</sub>

2

Voltmeter

ECU

THW

+B

3

Ohmmeter

ECU

E<sub>2</sub>

1

There is no voltage between ECU terminals THW and E<sub>21</sub> (E<sub>21</sub>).

(IG SW ON)

OK

2

Check that there is voltage between ECU terminal +B (+B<sub>1</sub>) and body ground (IG SW ON)

NO

Refer to No. 11

Check wiring between ECU terminal E<sub>1</sub> and body ground.

OK

3

Check water temp. sensor.

BAD

Replace water temp. sensor.

OK

Check wiring between ECU and water temp. sensor.

BAD

Repair or replace.

Try another ECU.

| No. | Terminals            | Trouble    | Condition                   | STD Voltage |
|-----|----------------------|------------|-----------------------------|-------------|
| 15  | STA - E <sub>1</sub> | No voltage | Ignition switch ST position | 6 - 12 V    |

ECU

STA

E<sub>1</sub>

Ignition Switch

Neutral Start Switch (A/T)

Starter Relay (M/T)

Clutch Start Switch (M/T)

Starter

AM<sub>1</sub> (40A)

ALT (80A)

Main (20L)

Battery

Fusible Link

1

Voltmeter

ECU

STA

E<sub>1</sub>

2

Ohmmeter

ECU

E<sub>1</sub>

3

Voltmeter

STA (Terminal 50)

1

There is no voltage between ECU terminals STA and E<sub>1</sub> (IG SW ST)

Check starter operation.

OK

2

Check wiring between ECU terminal E<sub>1</sub> and body ground.

BAD

Repair or replace.

Check fusible link, battery, wiring and ignition switch.

OK

3

Check that there is voltage at STA (50) terminal of starter (IG SW ST) STD voltage: 9 - 11 V

NO

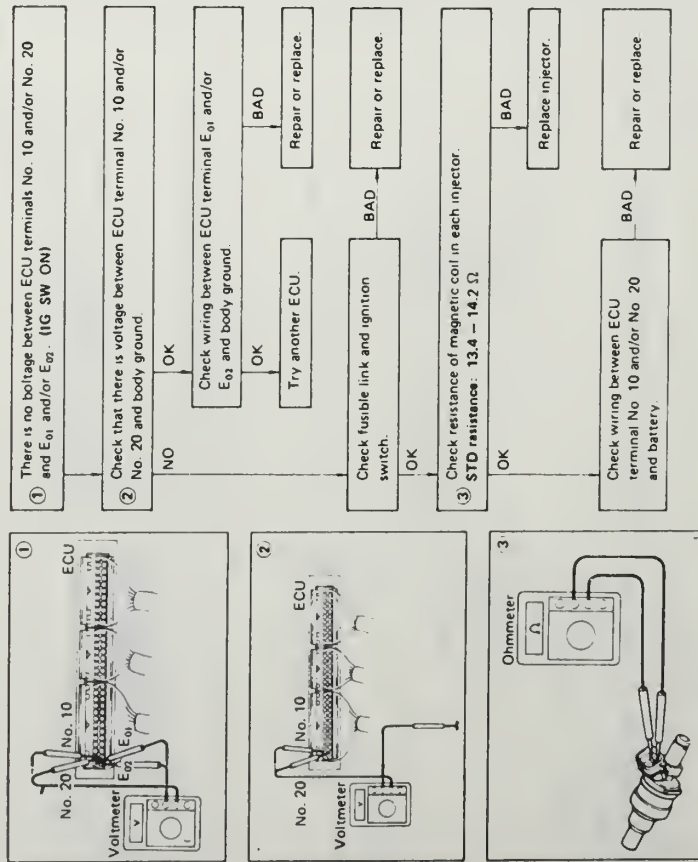
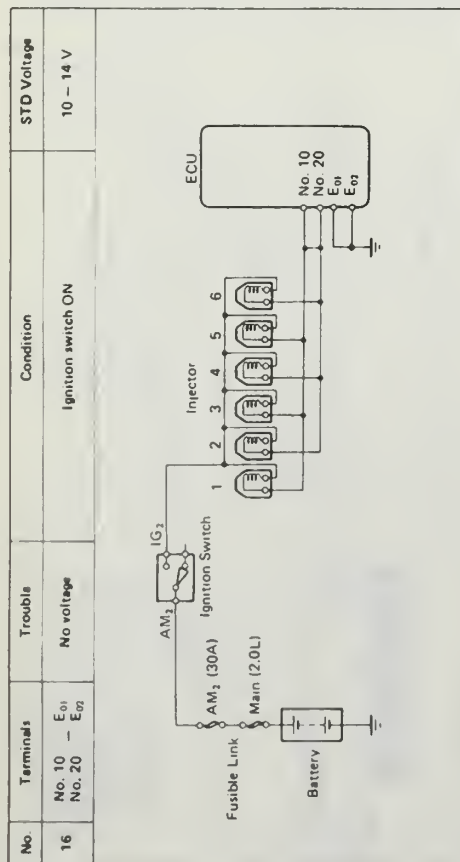
Check wiring between ignition switch ST terminal and starter STA (50) terminal

OK

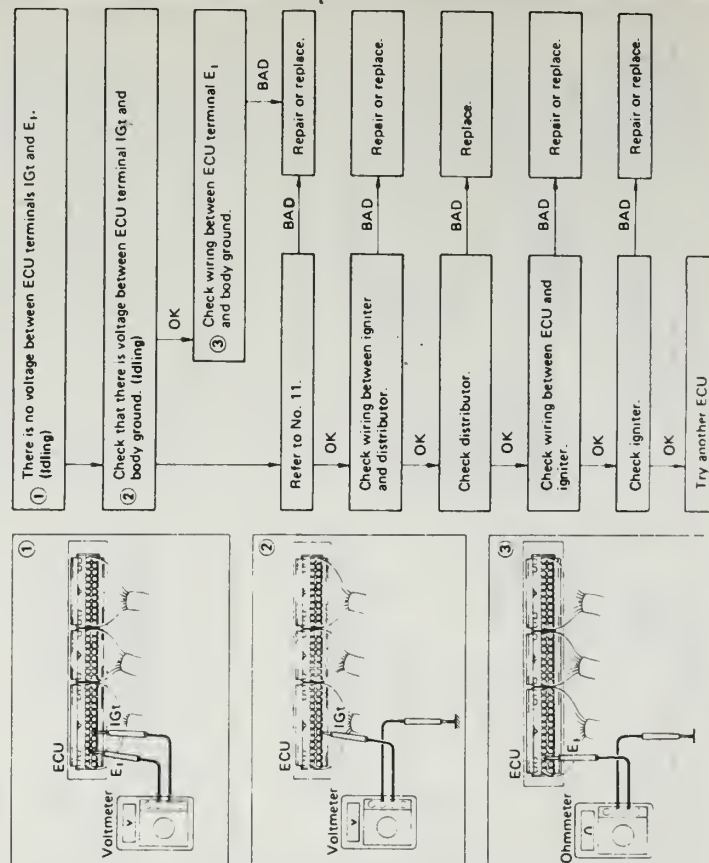
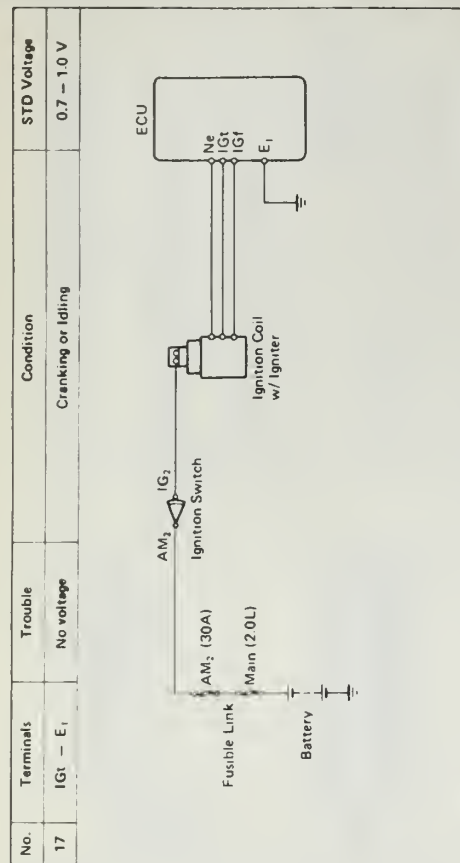
Check starter

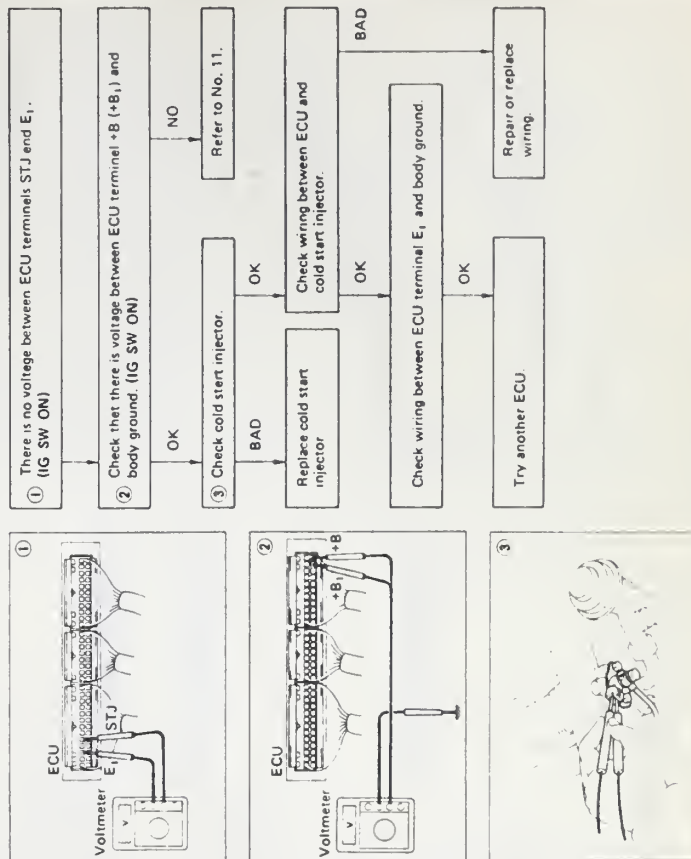
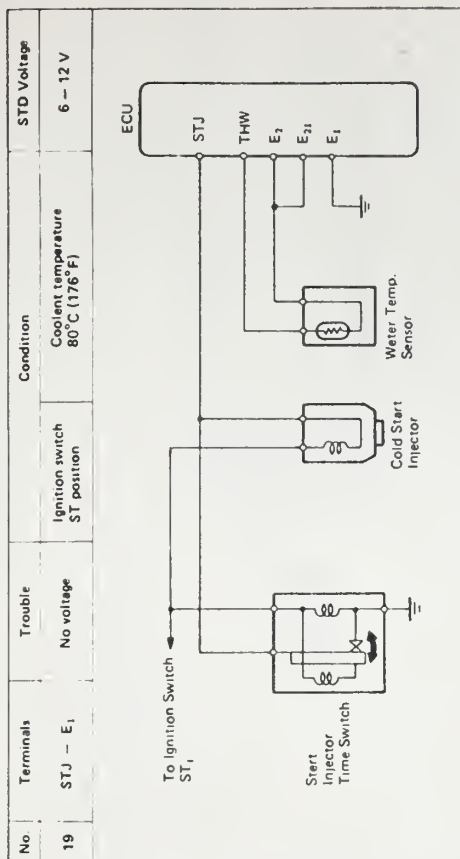
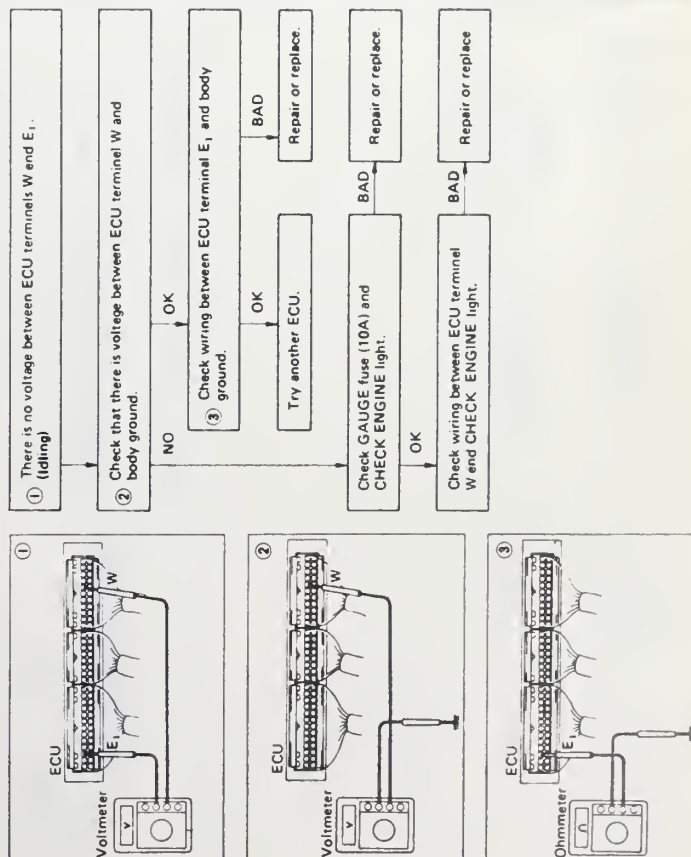
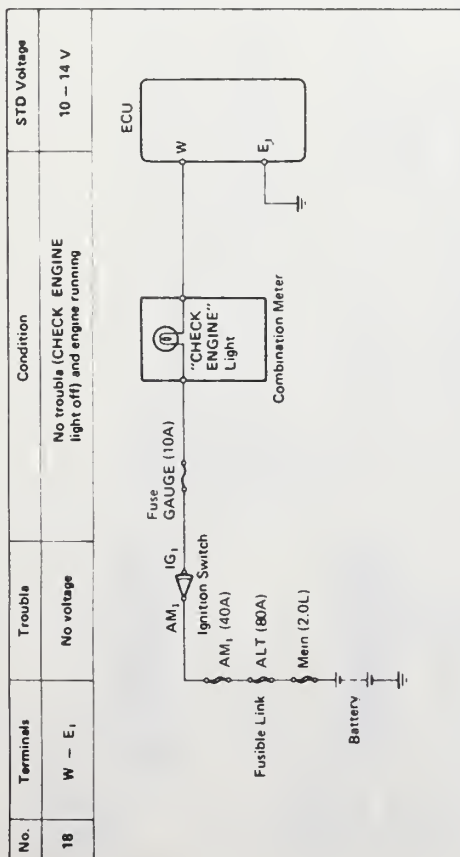


# ECU TEST NO.16 — 1990 TRUCK AND 4RUNNER WITH 3VZ-E EXCEPT FEDERAL WITH MANUAL TRANS

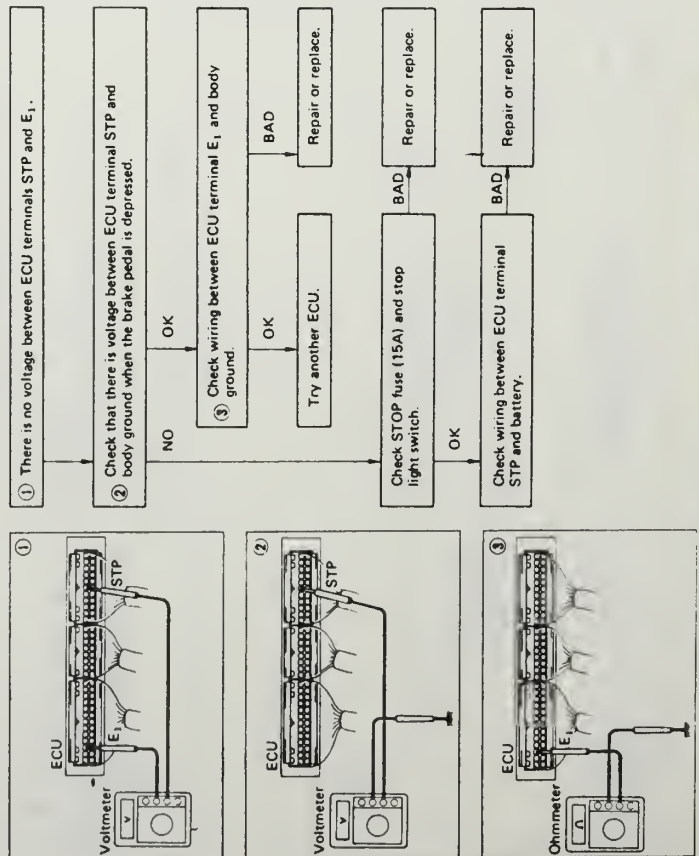
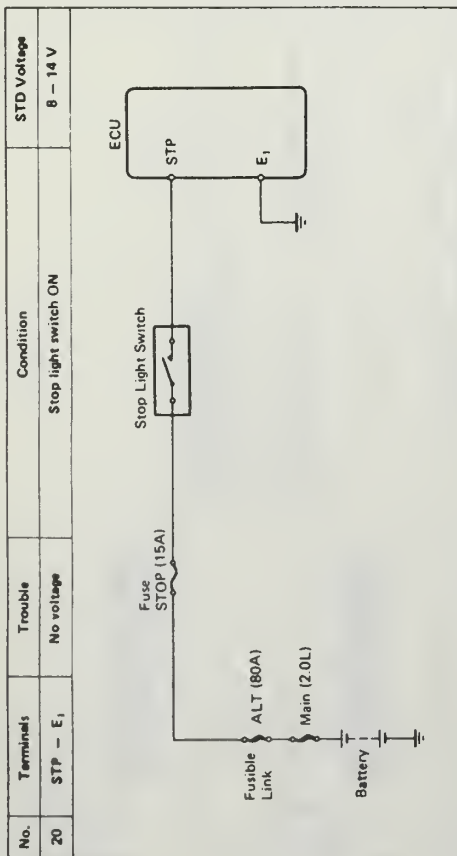


# ECU TEST NO.17 — 1990 TRUCK AND 4RUNNER WITH 3VZ-E EXCEPT FEDERAL WITH MANUAL TRANS

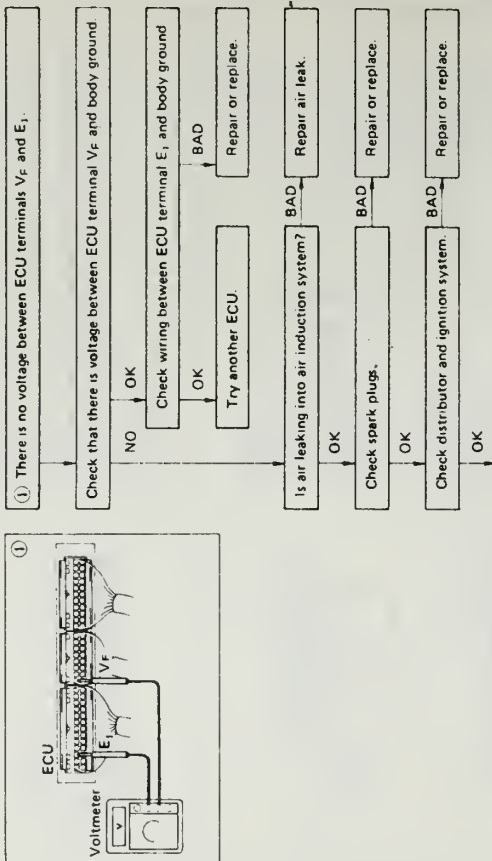
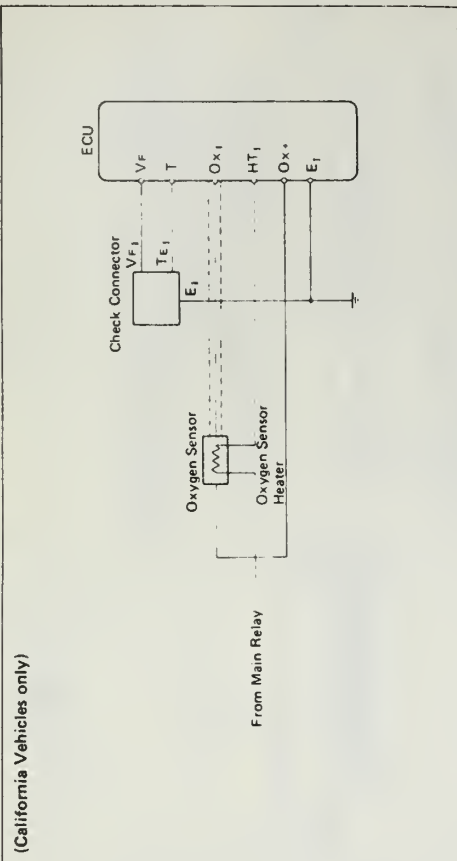




# ECU TEST NO.20 — 1990 TRUCK AND 4RUNNER WITH 3VZ-E EXCEPT FEDERAL WITH MANUAL TRANS

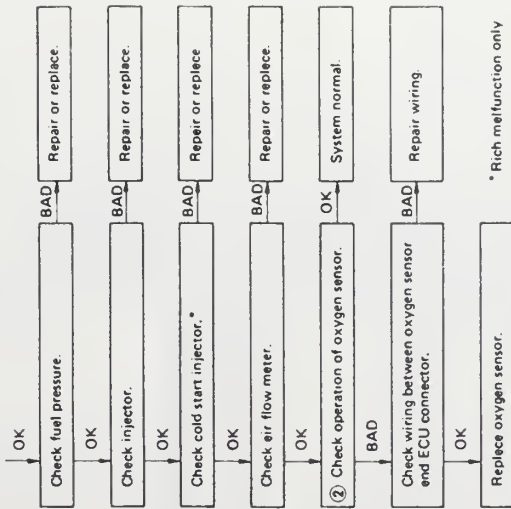


# OXYGEN SENSOR AND HEATER TEST — 1990 TRUCK AND 4RUNNER WITH 3VZ-E — CALIFORNIA ONLY

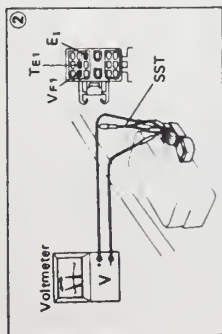




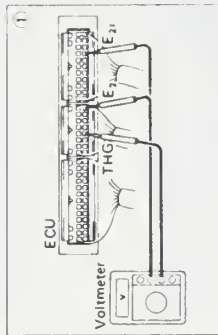
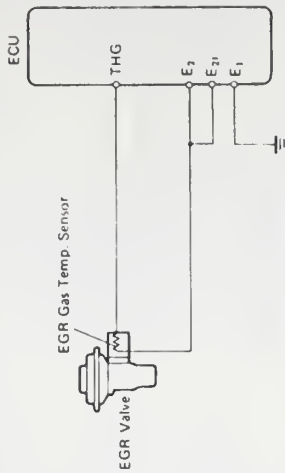
CONTINUED



\* Rich malfunction only



(California Vehicles only)



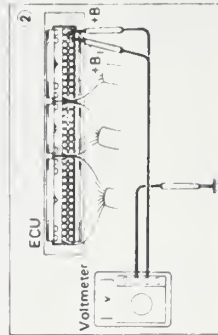
① There is no voltage between ECU terminals THG and E<sub>2</sub> (E<sub>1</sub> 1). (Engine running at 2,000 rpm)

② Check that there is voltage between ECU terminal +B (+B<sub>1</sub>) and body ground. (IG SW ON)

OK

NO

Refer to No. 11.



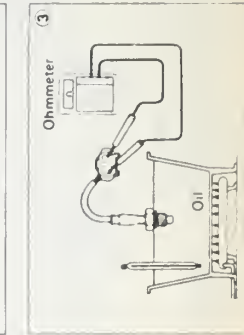
Check wiring between ECU terminal E<sub>1</sub> and body ground.

OK

BAD

Repair or replace

Repair or replace



③ Check EGR gas temp. sensor.

OK

BAD

Check wiring between ECU and EGR gas temp. sensor.

Replace EGR gas temp. sensor.

OK

BAD

Try another ECU.

Repair or replace

## FAULT CODES — 1991 TRUCK AND 4RUNNER WITH 4RUNNER WITH 3VZ-E

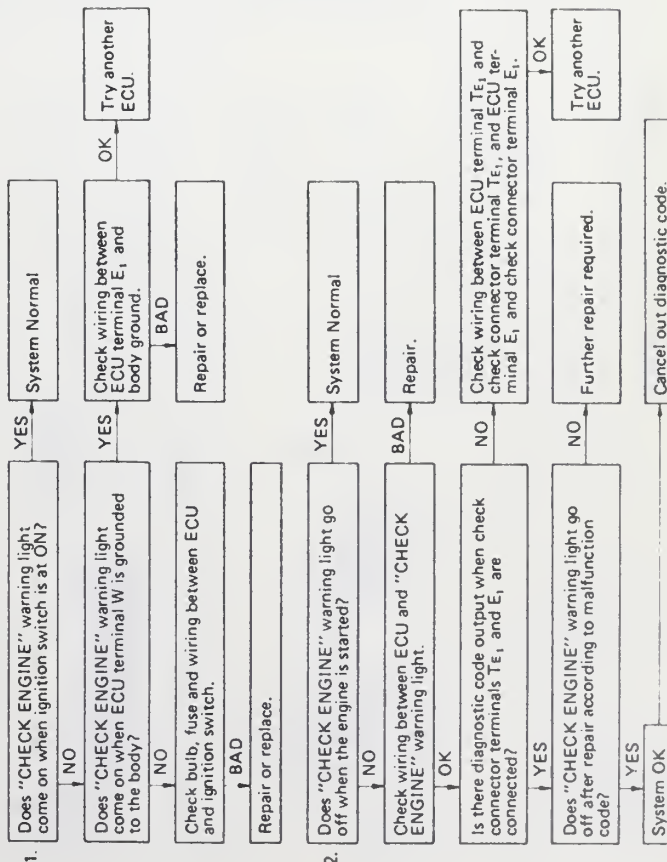
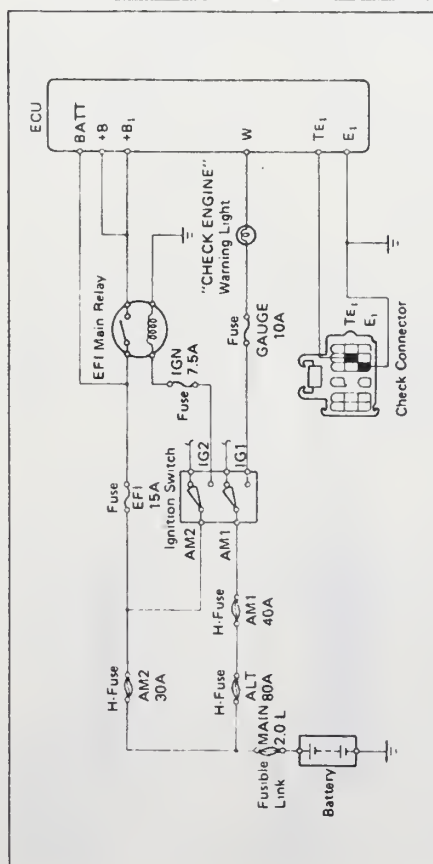
## FAULT CODES — 1991 TRUCK AND 4RUNNER WITH 3VZ-E. THE DESIGNATION C&C REFERS TO VEHICLES ASSEMBLED AS CAB AND CHASSIS ONLY

| Code No. | Number of "CHECK ENGINE" Warning Light | System                            | *1 "CHECK ENGINE" Warning Light | Diagnosis                                                                                                                                                                                                                                                                                      | Trouble Area                                                                                                                                                                                                                                                                                                                                                 | *2 Memory |
|----------|----------------------------------------|-----------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| —        | — J0000000                             | Normal                            | —                               | Output when no other code is recorded                                                                                                                                                                                                                                                          | —                                                                                                                                                                                                                                                                                                                                                            | —         |
| 12       | J00 J00                                | RPM Signal                        | ON                              | No G or NE signal is input to the ECU for 2 secs. or more after STA turns ON.                                                                                                                                                                                                                  | • Open or short in NE, G circuit<br>• Distributor<br>• Open or short in STA circuit<br>• ECU                                                                                                                                                                                                                                                                 | ○         |
| 13       | J00 J00                                | RPM Signal                        | ON                              | NE signal is not input to ECU for 50 msec. or more when engine speed is 1,000 rpm or more                                                                                                                                                                                                      | • Open or short in NE circuit<br>• Distributor<br>• ECU                                                                                                                                                                                                                                                                                                      | ○         |
| 14       | J00 J00                                | Ignition Signal                   | ON                              | IGF signal from igniter is not input to ECU for 6-6 consecutive ignition.                                                                                                                                                                                                                      | • Open or short in IGF or IGT circuit from igniter to ECU<br>• Igniter<br>• ECU                                                                                                                                                                                                                                                                              | ○         |
| 21       | J00 J00                                | Oxygen Sensor Signal              | ON                              | (1) Open or short in heater circuit of oxygen sensor for 500 msec. or more (HT) and engine speed is above 1,600 rpm.<br>(2) Amplitude of oxygen sensor signal (OX1) is reduced to between 0.35-0.70 V continuously for 60 secs. or more.<br>*6 (2 trip detection logic) (2)                    | • Open or short in heater circuit of oxygen sensor<br>• Oxygen sensor heater<br>• ECU<br>• Open or short in oxygen sensor circuit<br>• Oxygen sensor<br>• ECU                                                                                                                                                                                                | ○         |
| 22       | J00 J00                                | Water Temp. Sensor Signal         | ON                              | Open or short in water temp. sensor circuit for 500 msec. or more. (THW)                                                                                                                                                                                                                       | • Open or short in water temp. sensor circuit<br>• Water temp. sensor<br>• ECU                                                                                                                                                                                                                                                                               | ○         |
| 24       | J00 J00                                | Intake Temp. Sensor Signal        | *3 ON                           | Open or short in intake air temp. sensor circuit for 500 msec. or more. (THA)                                                                                                                                                                                                                  | • Open or short in intake air temp. circuit<br>• Intake air temp. sensor<br>• ECU                                                                                                                                                                                                                                                                            | ○         |
| 25       | J00 J00                                | Air/Fuel Ratio Sensor Malfunction | ON                              | (1) Oxygen sensor output is less than 0.45 V for at least 90 sec. when engine speed is warmed up idling at 2,000 rpm.<br>*4 (2) When marked variation is detected in oxygen sensor output, feedback control, idle switch on and feedback condition.<br>*6 (2 trip detection logic) (1) and (2) | • Engine ground bolt loose<br>• Open or short in oxygen sensor circuit<br>• Open in injector circuit<br>• Fuel line pressure (injector blockage, etc.)<br>• Open or short in oxygen sensor circuit<br>• Oxygen sensor<br>• Ignition system<br>• Water temp. sensor<br>• Air flow meter (Air intake)<br>• ECU                                                 | ○         |
| 26       | J00 J00                                | Air/Fuel Ratio Sensor Malfunction | ON                              |                                                                                                                                                                                                                                                                                                | • Engine ground bolt loose<br>• Open in E1 circuit<br>• Short in injector circuit<br>• Fuel line pressure (injector blockage, etc.)<br>• Open or short in cold start injector circuit<br>• Cold start injector<br>• Open or short in oxygen sensor circuit<br>• Oxygen sensor<br>• Water temp. sensor<br>• Air flow meter<br>• Compression pressure<br>• ECU | ○         |

| Code No. | Number of blinks "CHECK ENGINE" Warning Light | System                          | *1 "CHECK ENGINE" Warning Light | Diagnosis                                                                                                                                                                                                                                                                                                                                                           | Trouble Area                                                                                                                           | *2 Memory |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
|----------|-----------------------------------------------|---------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|-----|---|-----|-----|-----|--------|--|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 31       |                                               | Air Flow Meter Signal           | ON                              | At idling, open or short detected continuously for 500 msec. or more in air flow meter circuit<br>• Open — VC<br>• Short — VC—E2                                                                                                                                                                                                                                    | • Open or short in air flow meter circuit<br>• Air flow meter<br>• ECU                                                                 | ○         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| 32       |                                               | Air Flow Meter Signal           | ON                              | Open or short detected continuously for 500 msec. or more in air flow meter circuit<br>• Open — E2<br>• Short — VS—VC                                                                                                                                                                                                                                               |                                                                                                                                        | ○         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| 35       |                                               | HAC Sensor Signal (only C&C)    | OFF                             | Open or short detected in HAC sensor circuit for 500 msec. or more                                                                                                                                                                                                                                                                                                  | • ECU                                                                                                                                  | ○         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| 41       |                                               | Throttle Position Sensor Signal | *3 ON                           | Open or short detected in throttle position sensor signal (VTA) for 500 msec. or more. IDL contact is ON and VTA output exceeds 1.45 V.                                                                                                                                                                                                                             | • Open or short in throttle position sensor circuit<br>• Throttle position sensor<br>• ECU                                             | ○         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| 42       |                                               | Vehicle Speed Sensor Signal     | OFF                             | SPD signal is not input to the ECU for at least 8 seconds during high load driving with engine speed between 2,750 rpm and 4,000 rpm.                                                                                                                                                                                                                               | • Open or short in vehicle speed sensor circuit<br>• Vehicle speed sensor<br>• ECU                                                     | ○         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| 43       |                                               | Starter Signal                  | OFF                             | Starter signal (STA) is not input to ECU even once until engine reaches 800 rpm or more when cranking.                                                                                                                                                                                                                                                              | • Open or short in starter signal circuit<br>• Open or short in IG SW or main relay circuit<br>• ECU                                   | ○         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| 52       |                                               | Knock Sensor Signal             | ON                              | With engine speed between 1,600 rpm — 5,200 rpm, signal from knock sensor is not input to ECU for 5 revolution. (KNC)                                                                                                                                                                                                                                               | • Open or short in knock sensor circuit<br>• Knock sensor (looseness, etc.)<br>• ECU                                                   | ○         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| 53       |                                               | Knock Control Signal            | ON                              | Engine speed is between 850 rpm and 1,600 rpm and engine control malfunction is detected (for knock control malfunction)                                                                                                                                                                                                                                            | • ECU                                                                                                                                  | X         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| *5 71    |                                               | EGR System Malfunction          | ON                              | EGR gas temp. sensor signal (THG) is below "A" after driving for 240 seconds in EGR operation range.<br><table border="1"><thead><tr><th></th><th>C&amp;C</th><th>THW</th><th>THA</th></tr></thead><tbody><tr><td>A</td><td>THW</td><td>THA</td><td>THA</td></tr><tr><td>Others</td><td></td><td></td><td></td></tr></tbody></table><br>*6 (2 trip detection logic) |                                                                                                                                        | C&C       | THW | THA | A | THW | THA | THA | Others |  |  |  | • Open in EGR gas temp. sensor circuit<br>• Open in VSV circuit for EGR<br>• EGR vacuum hose disconnected, valve stuck<br>• Malfunction in EGR gas passage<br>• ECU | ○ |
|          | C&C                                           | THW                             | THA                             |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                        |           |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| A        | THW                                           | THA                             | THA                             |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                        |           |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| Others   |                                               |                                 |                                 |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                        |           |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |
| 51       |                                               | Switch Condition Signal         | OFF                             | Displayed when A/C is ON, IDL contact OFF or shift position in "R", "D", "2", or "1" ranges with the check terminals E1 and TE1 connected.                                                                                                                                                                                                                          | • A/C switch circuit<br>• Throttle position sensor IDL circuit<br>• Neutral start switch circuit<br>• Accelerator pedal/cable<br>• ECU | X         |     |     |   |     |     |     |        |  |  |  |                                                                                                                                                                     |   |

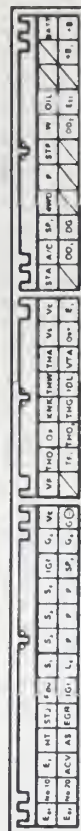
### REMARKS

- \*1: "ON" displayed in the diagnosis mode column indicates that the "CHECK ENGINE" Warning Light is lit up when a malfunction is detected.  
 \*2: "OFF" indicates that the "CHECK ENGINE" does not light up during malfunction diagnosis, even if a malfunction is detected.  
 \*3: "ON" in the memory column indicates that a diagnostic code is recorded in the ECU memory when a malfunction occurs. "X" indicates that a diagnostic code is not recorded in the ECU memory even if a malfunction occurs. Accordingly, output of diagnostic results is performed with the IG SW ON.  
 \*4: The "CHECK ENGINE" Warning Light comes on if malfunction occurs only for California specifications.  
 \*5: No (2) in the diagnostic contents of codes No. 25 and 26 apply to California specification vehicles only, while (1) applies to all models.  
 \*6: Code 71 is used only for California specifications.  
 \*7: \*2 trip detection logic.



| Symbol | Terminal name                   | Symbol  | Terminal name            | Symbol  | Terminal name               |
|--------|---------------------------------|---------|--------------------------|---------|-----------------------------|
| E01    | ENGINE GROUND                   | *1 L    | NEUTRAL START SWITCH     | ** O1 + | OXYGEN SENSOR               |
| E02    | ENGINE GROUND                   | IG1     | IGNITER                  | Vc      | AIR FLOW METER              |
| No.10  | INJECTOR                        | *1 SP2  | SPEED SENSOR             | E2      | SENSOR GROUND               |
| E1     | INJECTOR                        | G1      | DISTRIBUTER              | STA     | STARTER SWITCH              |
| ACV    | VSV (for A/C)                   | G2      | DISTRIBUTER              | A/C     | COMPRESSOR SWITCH           |
| HT     | OXYGEN SENSOR HEATER            | Ne      | DISTRIBUTER              | *1 OD1  | CRUISE CONTROL COMPUTER     |
| AS     | VSV (for ASI)                   | G3      | DISTRIBUTER              | SP1     | SPEED SENSOR                |
| STJ    | COLD START INJECTOR             | Vr      | CHECK CONNECTOR          | *1 DG   | CHECK CONNECTOR             |
| EGR    | VSV (for EGR)                   | *2 TH01 | T/M OIL TEMP. SENSOR     | *5 4WD  | 4WD SWITCH                  |
| FPU    | VSV (for Fuel pressure control) | Te1     | CHECK CONNECTOR          | *1 P    | PATTERN SELECT SWITCH       |
| IG1    | IGNITER                         | Ox      | OXYGEN SENSOR            | STP     | STOP LIGHT SWITCH           |
| *1 S1  | ECT SOLENOID                    | *2 TH02 | T/M OIL TEMP. SENSOR     | W       | CHECK ENGINE WARNING LIGHT  |
| *2 L1  | TRANSFER POSITION SWITCH        | KNK     | KNOCK SENSOR             | *1 OD2  | CRUISE CONTROL COMPUTER     |
| *1 S2  | ECT SOLENOID                    | *3 THG  | EGR GAS TEMP. SENSOR     | *2 OIL  | A/T OIL TEMP. WARNING LIGHT |
| *1 N   | NEUTRAL START SWITCH            | THW     | WATER TEMP. SENSOR       | E21     | SENSOR GROUND               |
| *1 S3  | ECT SOLENOID                    | IDL     | THROTTLE POSITION SENSOR | +B1     | MAIN RELAY                  |
| *1 2   | NEUTRAL START SWITCH            | THA     | AIR TEMP. SENSOR         | BATT    | BATTERY +B                  |
| *2 S4  | ECT SOLENOID                    | VTA     | THROTTLE POSITION SENSOR | +B      | MAIN RELAY                  |
|        |                                 | Vs      | AIR FLOW METER           |         |                             |

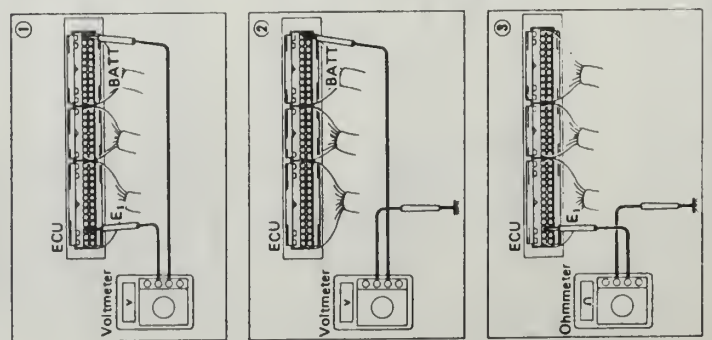
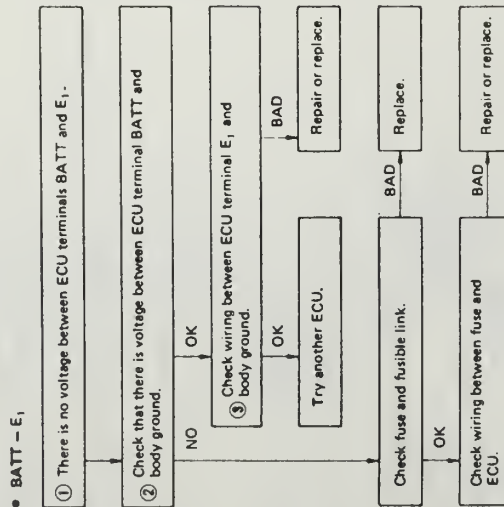
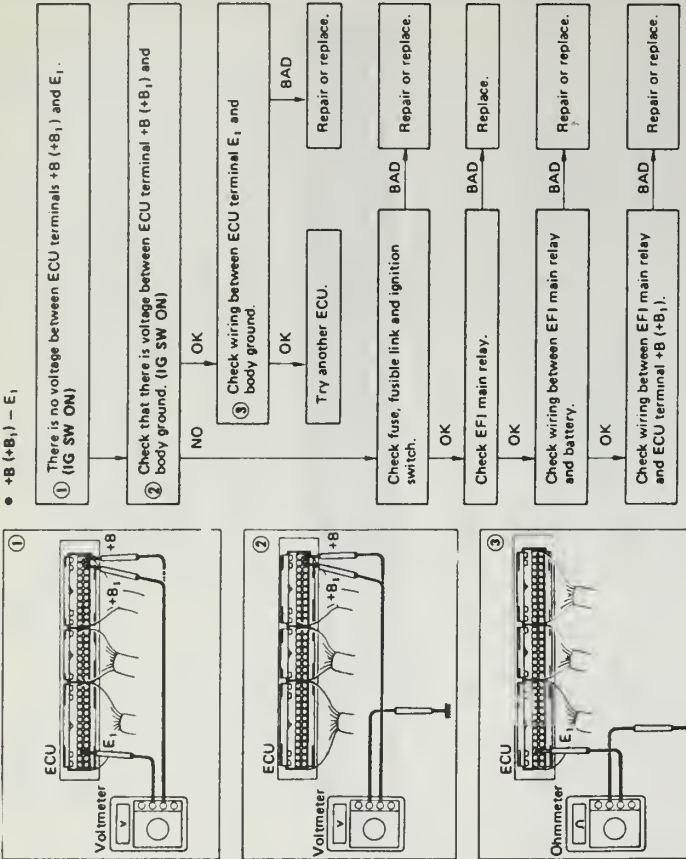
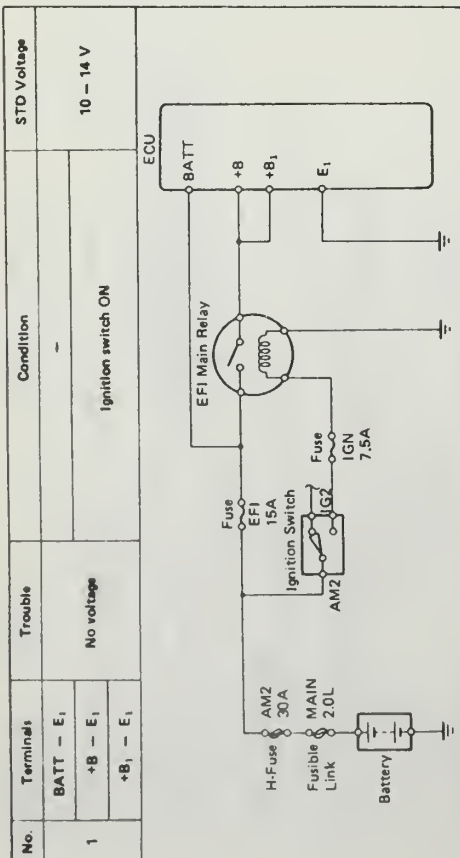
\*1: A/T only    \*2: 4WD A/T only    \*3: California and C & C all    \*4: California 2WD only    \*5: 4WD only



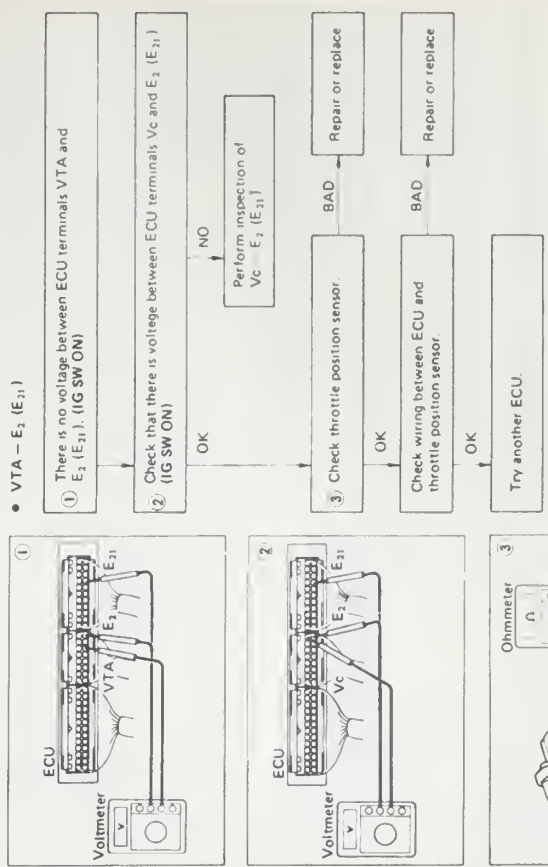
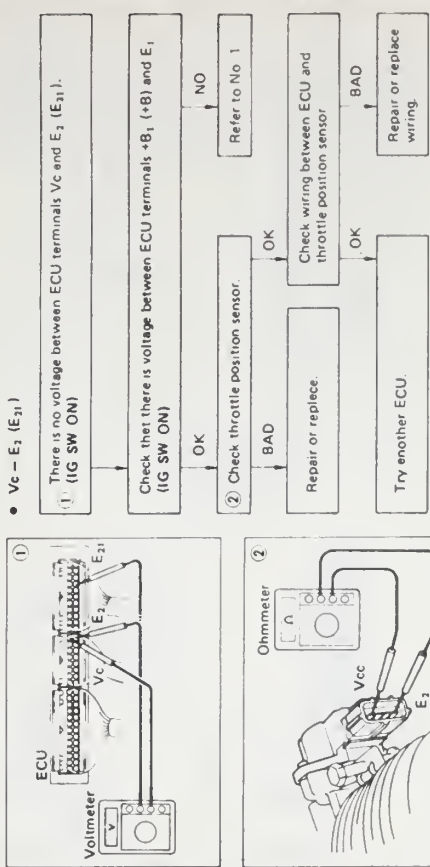
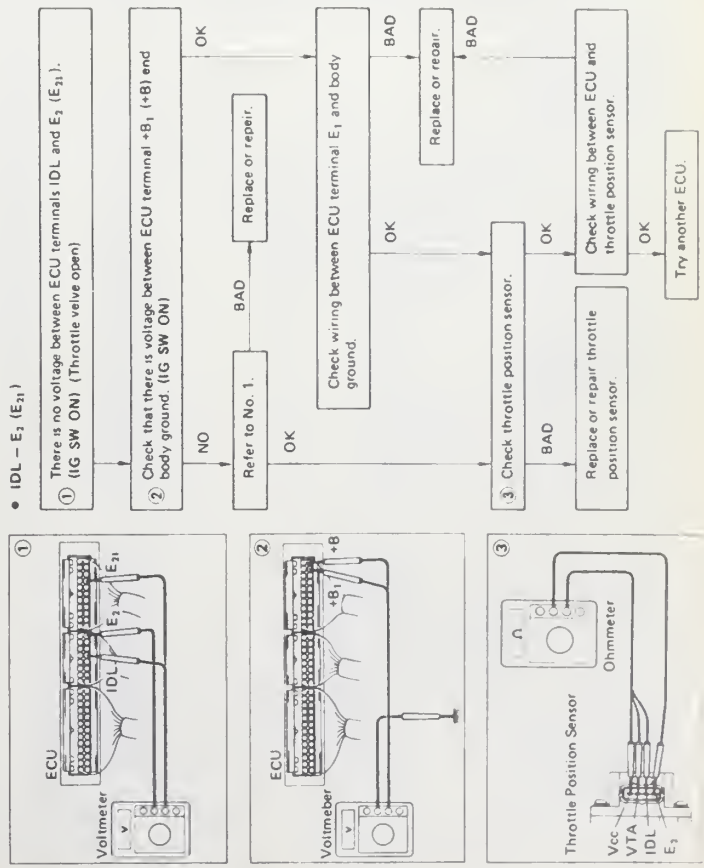
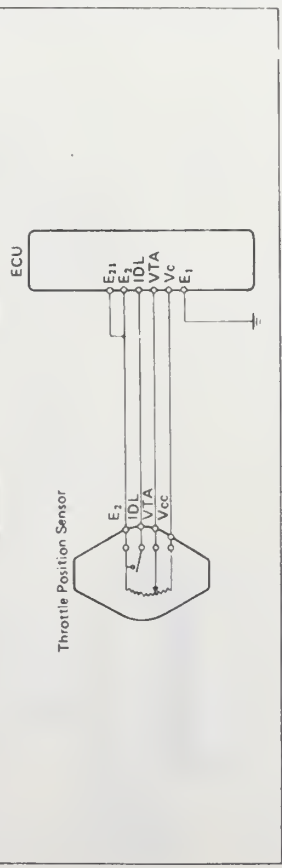


# ECU TEST NO.1 – 1991 TRUCK AND 4RUNNER WITH 3VZ-E

## 5 FUEL SYSTEM

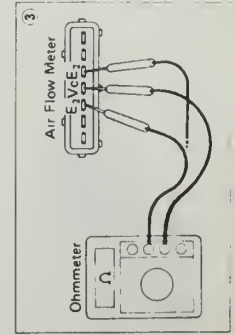
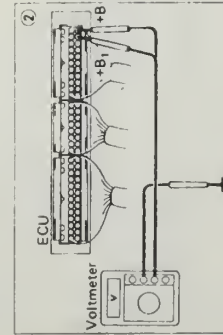
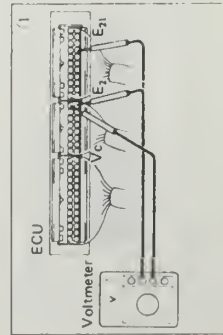
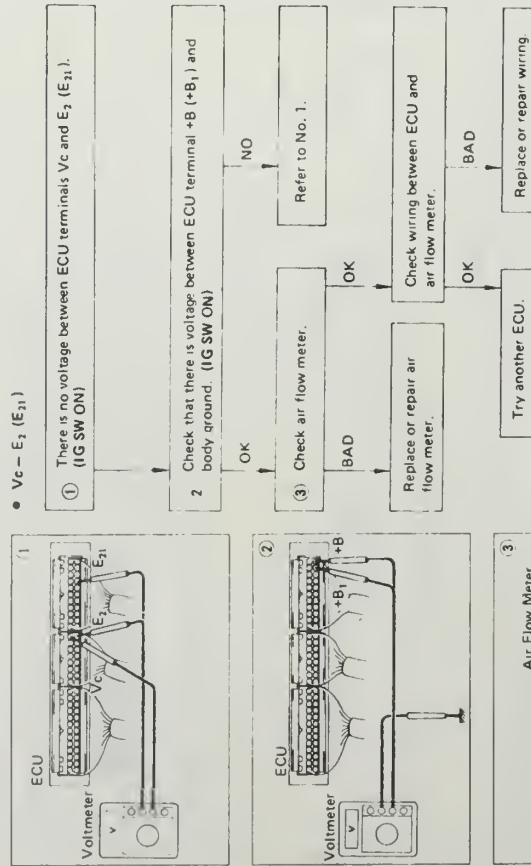
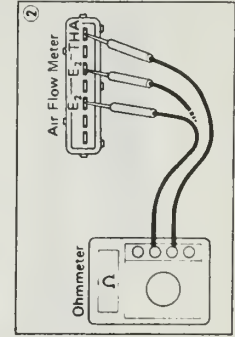
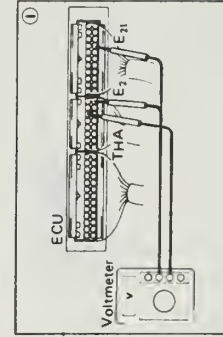
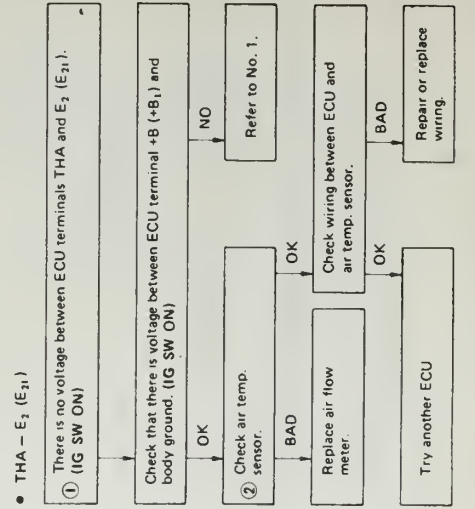
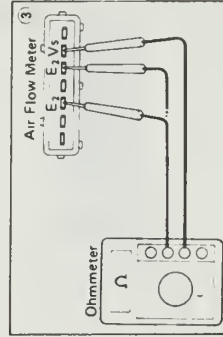
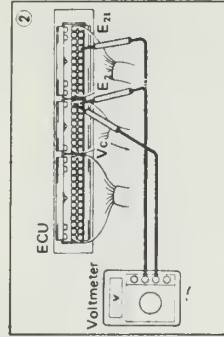
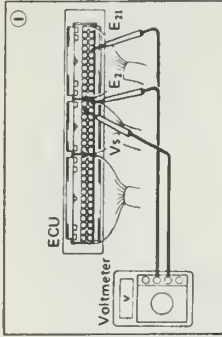
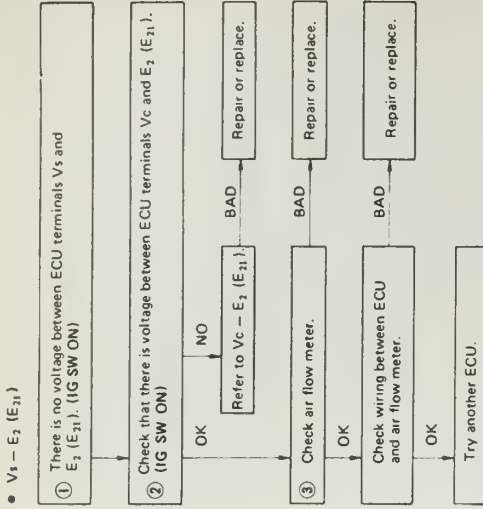


| No. | Terminals                                | Trouble    | Condition          | STD Voltage |
|-----|------------------------------------------|------------|--------------------|-------------|
| 2   | IDL - E <sub>31</sub> (E <sub>31</sub> ) | No voltage | Ignition switch ON | 8 - 14 V    |
|     | Vc - E <sub>3</sub> (E <sub>31</sub> )   |            |                    | 4 - 6 V     |
|     | VTA - E <sub>3</sub> (E <sub>31</sub> )  |            |                    | 0.1 - 1.0 V |
|     | VTA - E <sub>2</sub> (E <sub>31</sub> )  |            |                    | 3 - 5 V     |



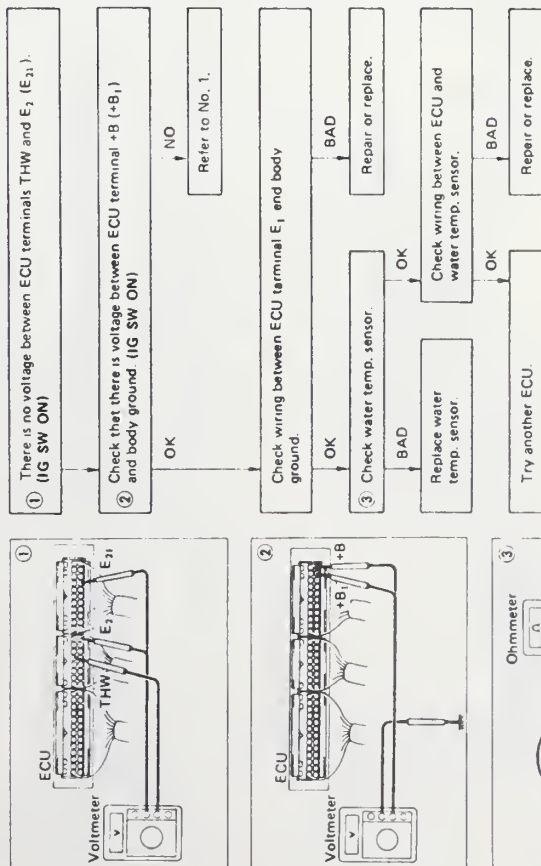
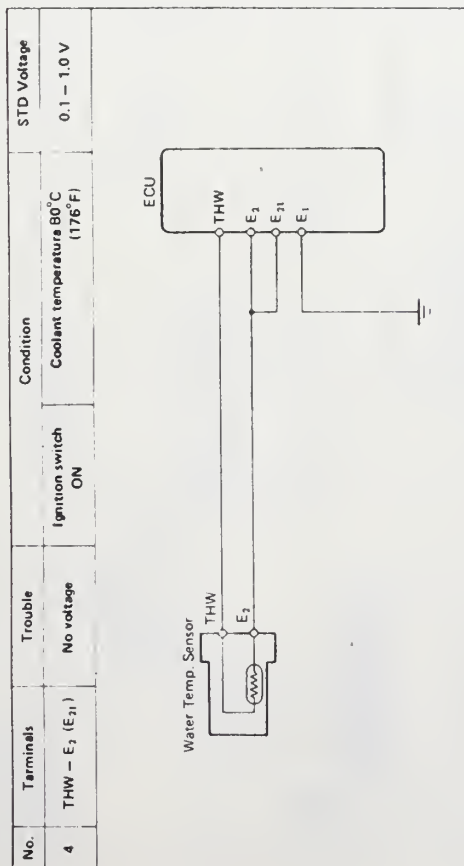
# 5 FUEL SYSTEM

| No. | Terminal                 | Trouble    | Condition                          | STD Voltage |
|-----|--------------------------|------------|------------------------------------|-------------|
| 3   | $V_c - E_2$ ( $E_{31}$ ) | No voltage | Ignition SW ON                     | 4 - 6 V     |
|     | $V_s - E_2$ ( $E_{31}$ ) |            | Measuring plate fully closed       | 3.7 - 4.3 V |
|     | $V_c - E_2$ ( $E_{31}$ ) |            | Measuring plate fully open         | 0.2 - 0.5 V |
|     | $THA - E_2$ ( $E_{31}$ ) |            | Idling                             | 2.3 - 2.8 V |
|     |                          |            | Intake air temperature 20°C (68°F) | 1 - 3 V     |

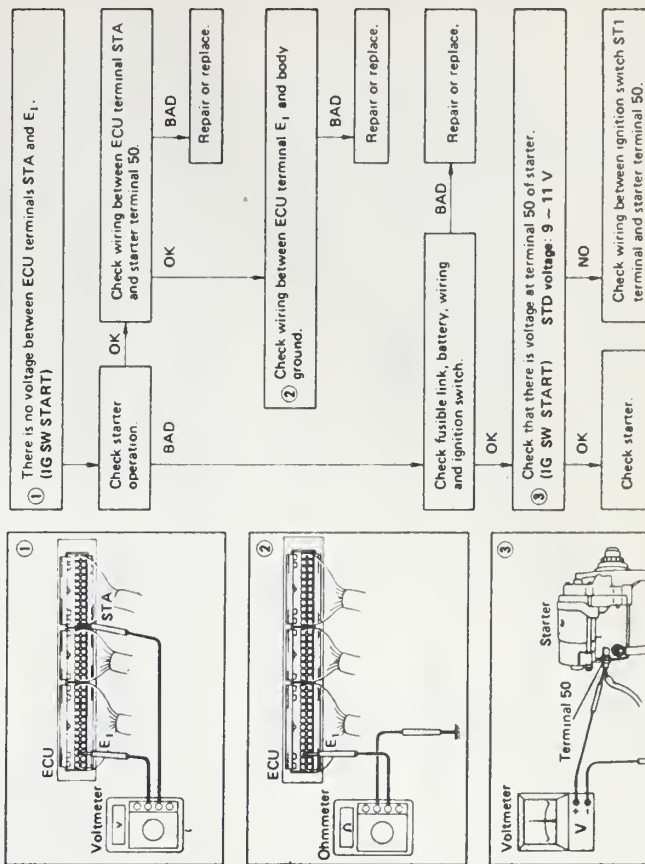
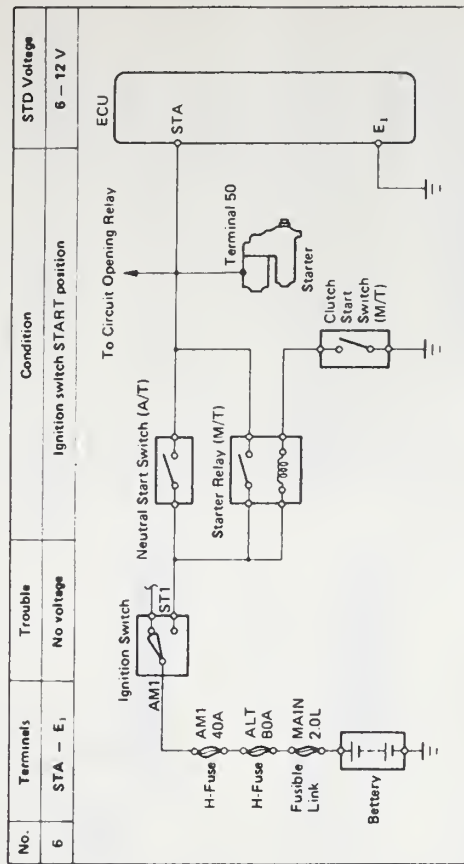
  




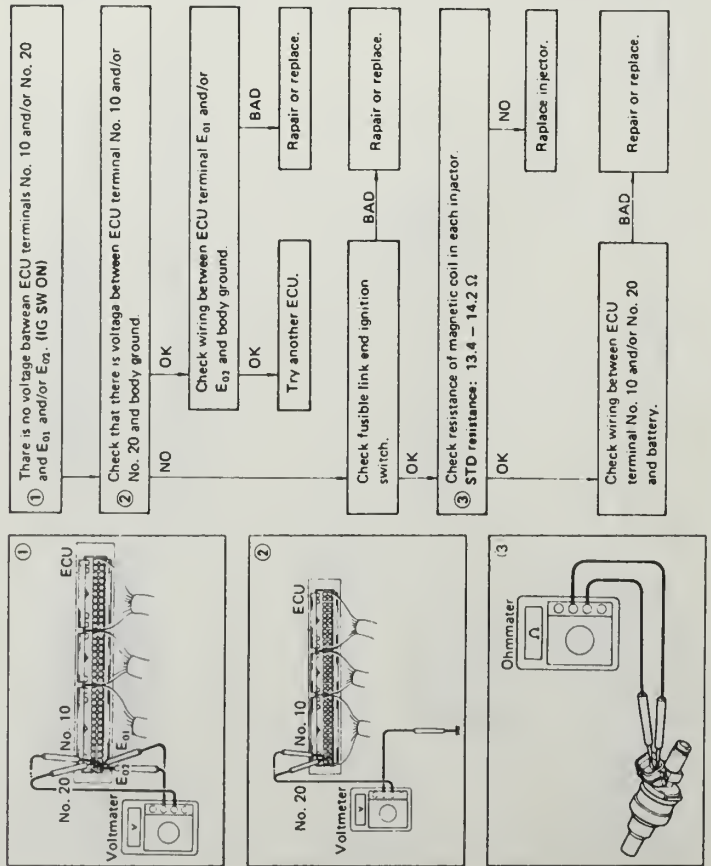
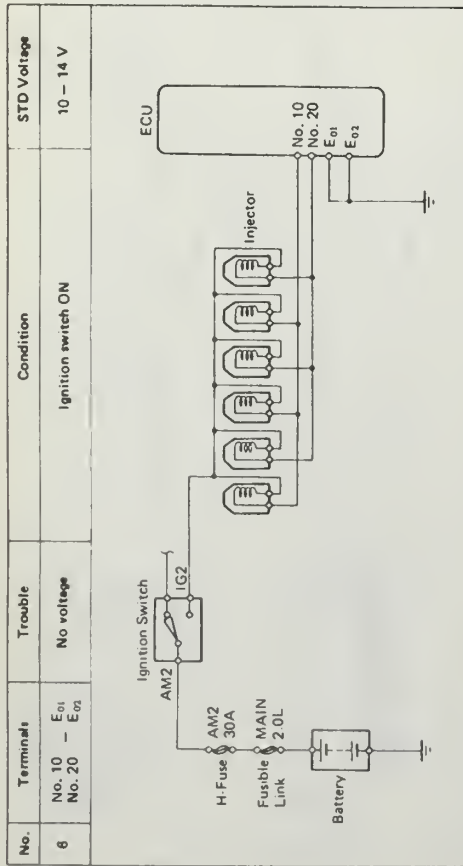
# ECU TEST NO.4 – 1991 TRUCK AND 4RUNNER WITH 3VZ-E



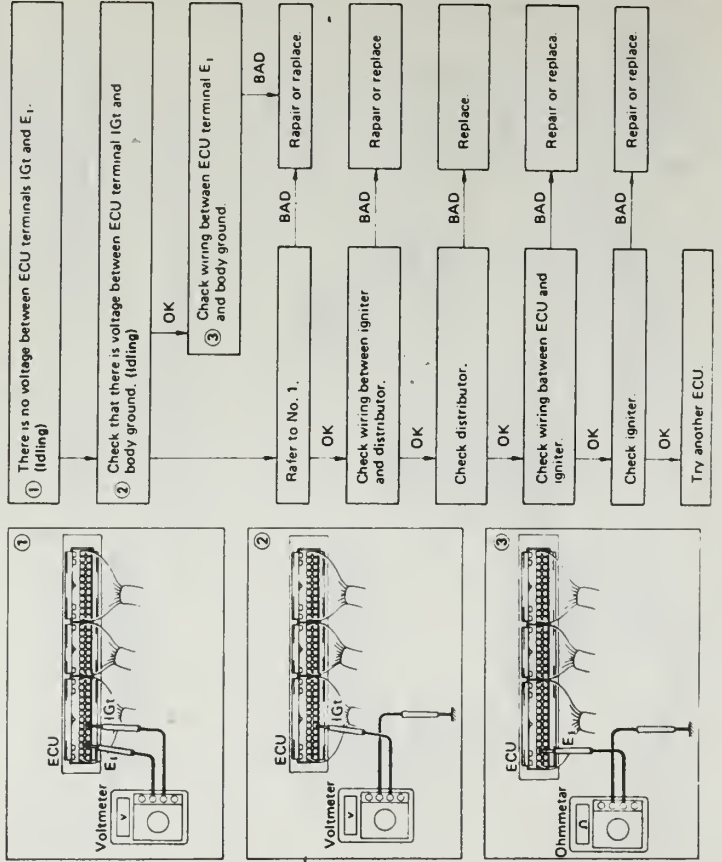
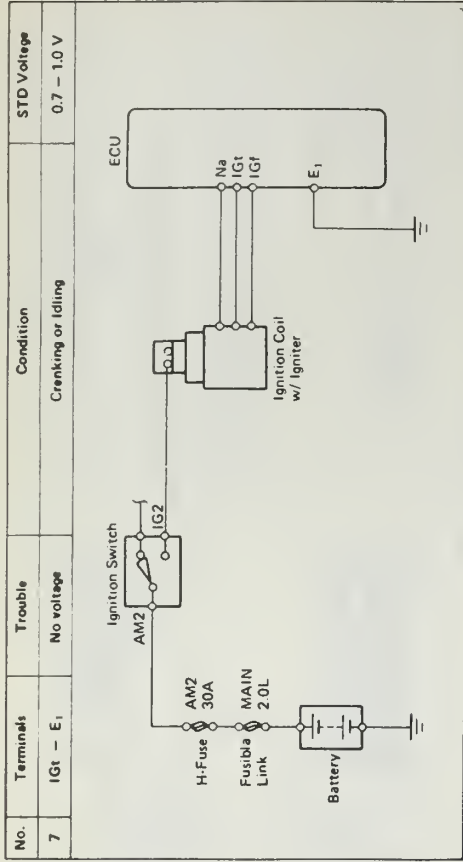
# ECU TEST NO.5 – 1991 TRUCK AND 4RUNNER WITH 3VZ-E



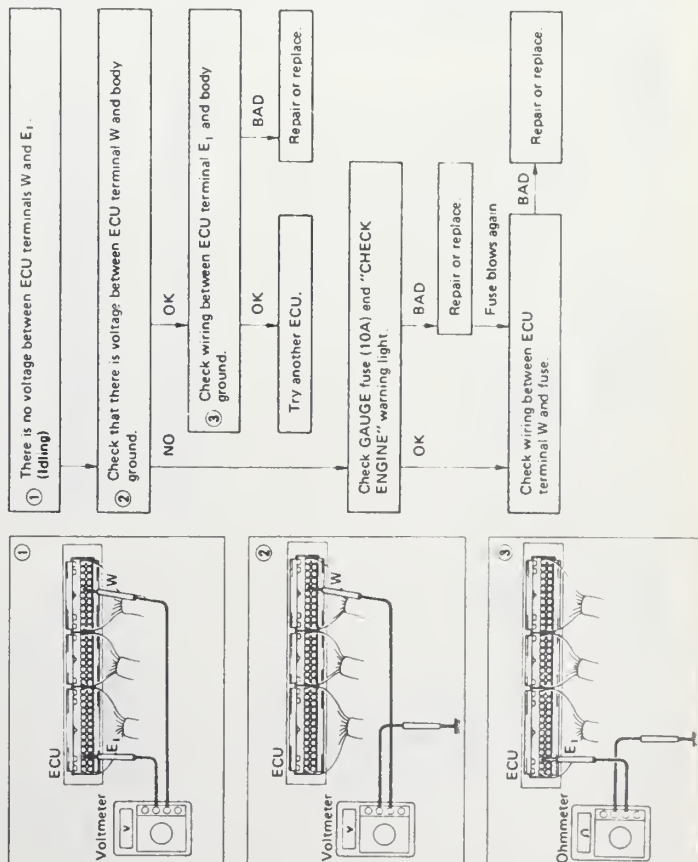
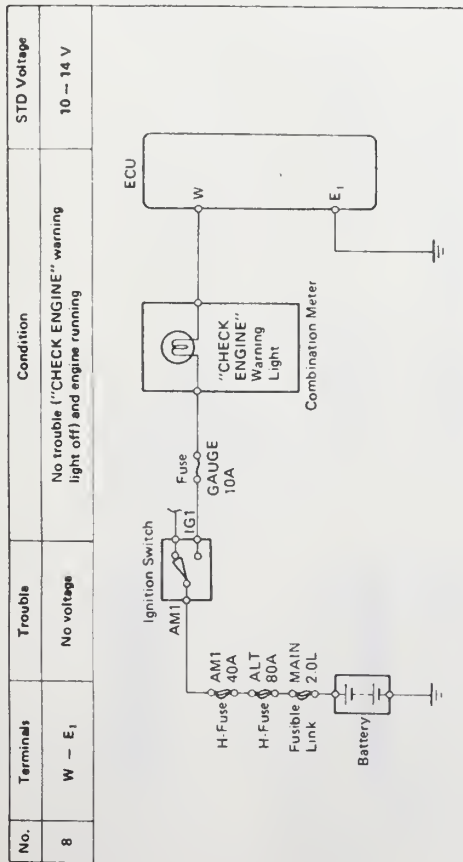
## ECU TEST NO.6 – 1991 TRUCK AND 4RUNNER WITH 3VZ-E



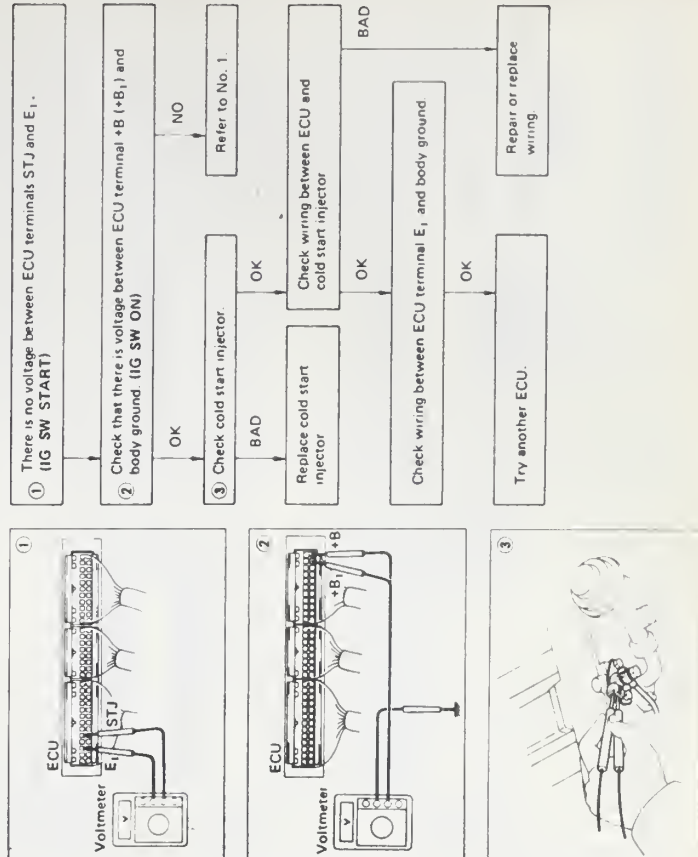
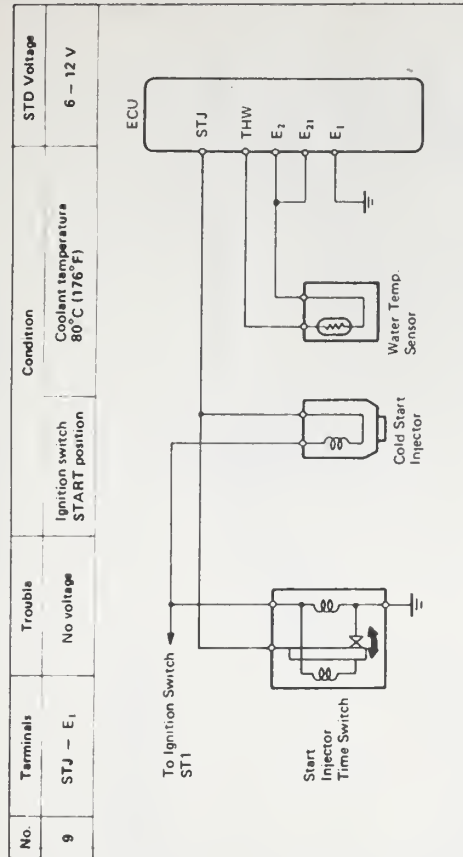
## ECU TEST NO.7 – 1991 TRUCK AND 4RUNNER WITH 3VZ-E



# ECU TEST NO.8 — 1991 TRUCK AND 4RUNNER WITH 3VZ-E



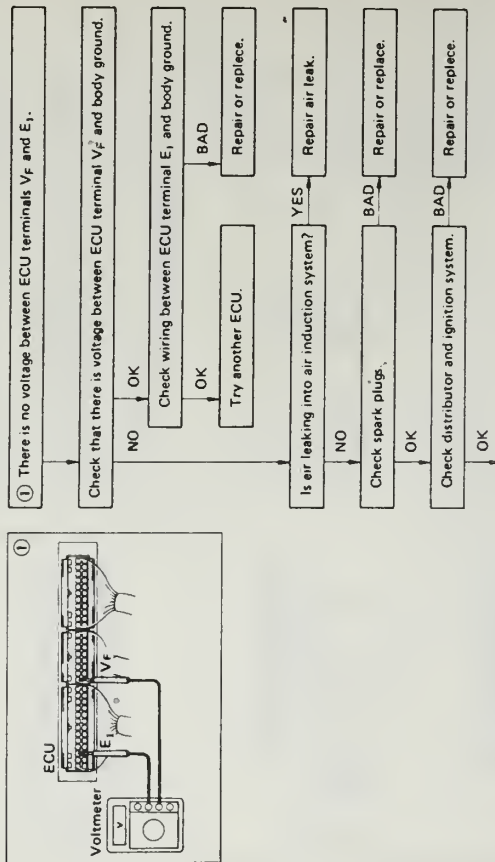
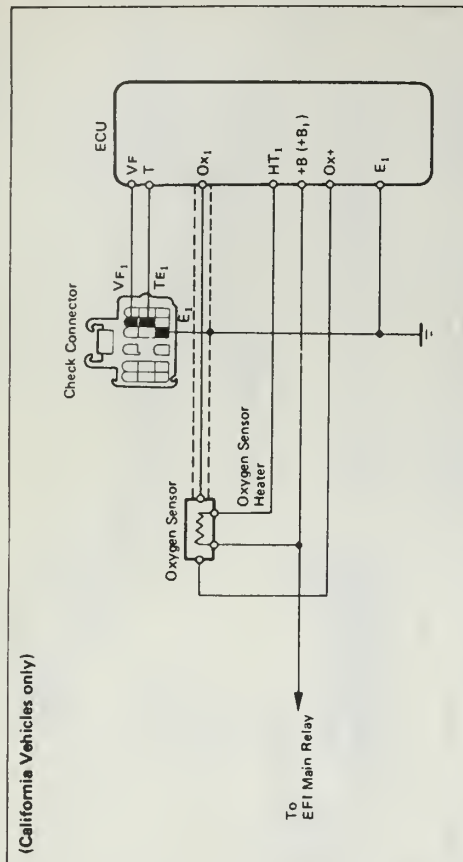
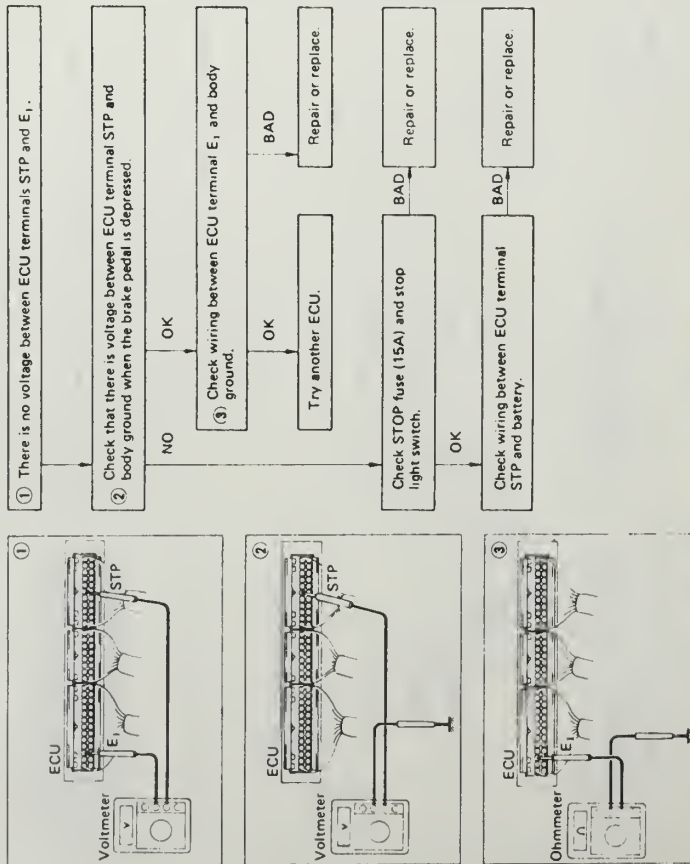
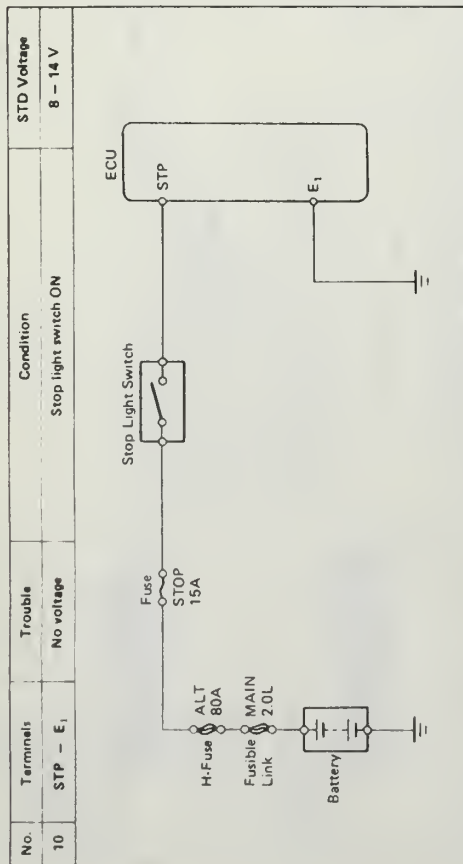
# ECU TEST NO.9 — 1991 TRUCK AND 4RUNNER WITH 3VZ-E



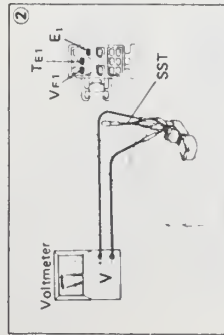
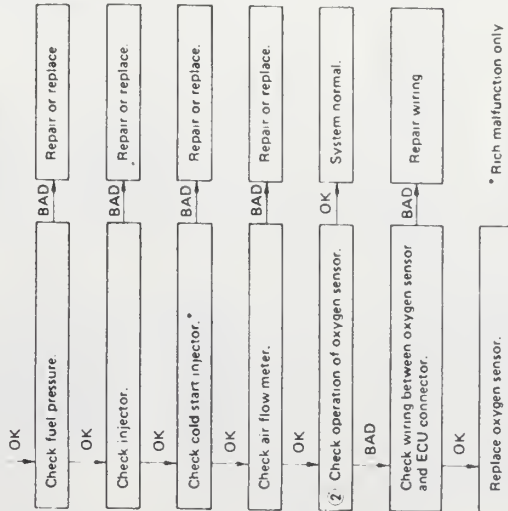


# ECU TEST NO.10 – 1991 TRUCK AND 4RUNNER WITH 3VZ-E

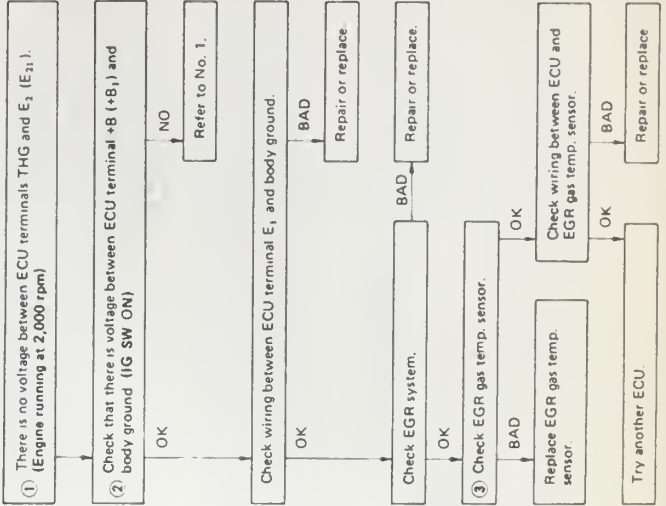
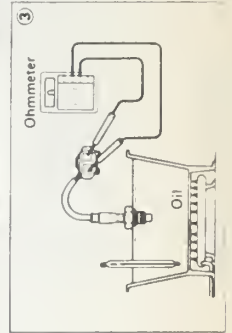
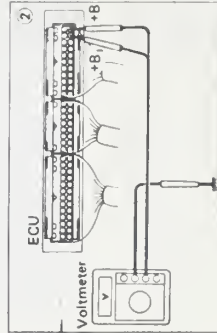
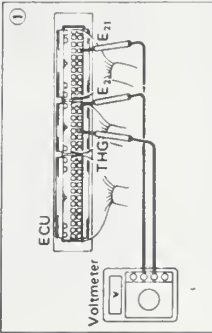
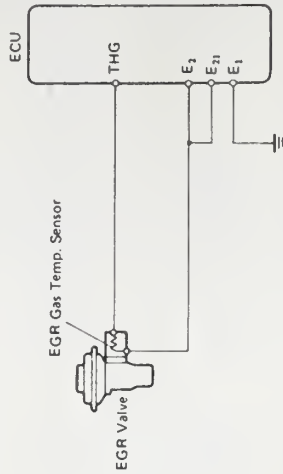
# OXYGEN SENSOR AND HEATER TEST – 1991 TRUCK AND 4RUNNER WITH 3VZ-E – CALIFORNIA ONLY



CONTINUED



(California Vehicles only)



## FAULT CODES — 1989-90 LAND CRUISER WITH 3F-E

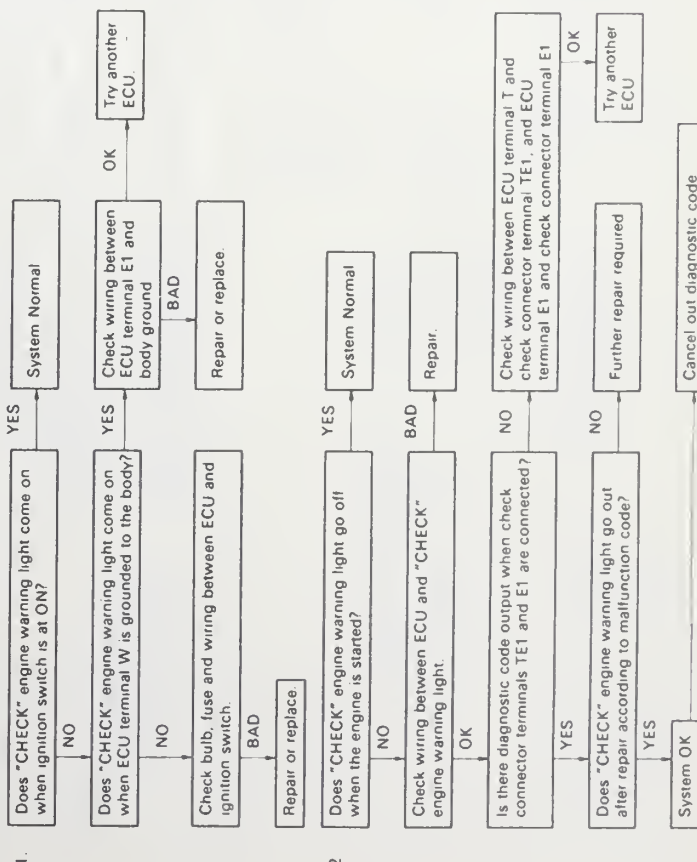
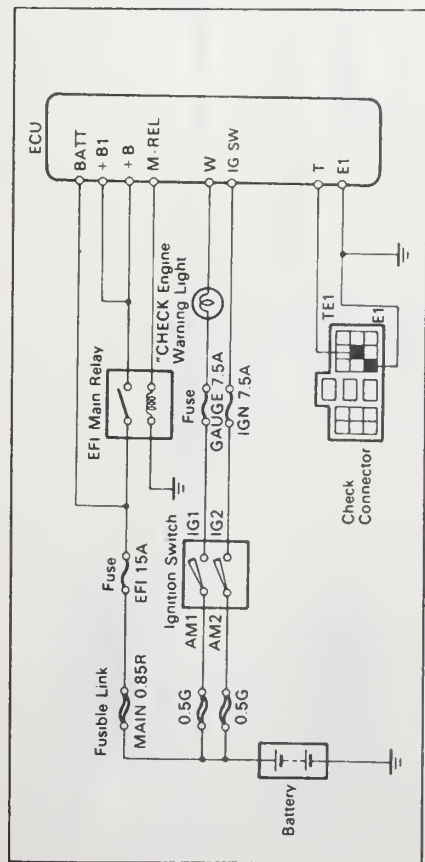
| Code No. | Number of Check engine blinks | System                          | Diagnosis                                                                                                                                                                                                                                                                                                                                                                                                               | Trouble area                                                                                                                                                                                                                           |
|----------|-------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| —        |                               | Normal                          | This appears when none of the other codes are identified                                                                                                                                                                                                                                                                                                                                                                | —                                                                                                                                                                                                                                      |
| 11       |                               | ECU (+ 8)                       | Momentary interruption in power supply to ECU                                                                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>Ignition switch circuit</li> <li>Ignition switch</li> <li>Main relay circuit</li> <li>Main relay</li> <li>ECU</li> </ul>                                                                        |
| 12       |                               | RPM Signal                      | No "NE" or "G" signal to ECU within 2 seconds after engine has been cranked                                                                                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>Distributor circuit</li> <li>Distributor</li> <li>Starter signal circuit</li> <li>ECU</li> </ul>                                                                                                |
| 13       |                               | RPM Signal                      | No "NE" signal to ECU when engine speed is above 1,000 rpm                                                                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Distributor circuit</li> <li>Distributor</li> <li>ECU</li> </ul>                                                                                                                                |
| 14       |                               | Ignition Signal                 | No "IGF" signal to ECU 6-8 times in succession                                                                                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>Igniter and ignition coil circuit</li> <li>Igniter and ignition coil</li> <li>ECU</li> </ul>                                                                                                    |
| 21       |                               | Oxygen Sensor Signal            | During air-fuel ratio feedback correction, voltage output from the oxygen sensor does not exceed a set value on the lean side and the rich side continuously for a certain period                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>Oxygen sensor circuit</li> <li>Oxygen sensor</li> <li>ECU</li> </ul>                                                                                                                            |
|          |                               | Oxygen Sensor Heater Signal     | Open or short circuit in oxygen sensor heater                                                                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>Oxygen sensor heater circuit</li> <li>Oxygen sensor heater</li> <li>ECU</li> </ul>                                                                                                              |
| 22       |                               | Water Temp Sensor Signal        | Open or short circuit in water temp. sensor signal                                                                                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Water temp. sensor circuit</li> <li>Water temp. sensor</li> <li>ECU</li> </ul>                                                                                                                  |
| 24       |                               | Intake Air Temp Sensor Signal   | Open or short circuit in intake air temp. sensor signal                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Intake air temp. sensor circuit</li> <li>Intake air temp. sensor</li> <li>ECU</li> </ul>                                                                                                        |
| 25       |                               | Air-fuel Ratio Lean Malfunction | <p>(1) When air-fuel ratio feedback compensation value or adaptive control value continues at the upper (lean) or lower (rich) limit</p> <p>(2) When air-fuel ratio feedback compensation value or adaptive control value feedback frequency is abnormally high during feedback condition</p> <p>HINT For condition (2), neither a lean (Code No. 25) nor a rich (Code No. 26) diagnosis is displayed consecutively</p> | <ul style="list-style-type: none"> <li>Injector circuit</li> <li>Injector</li> <li>Fuel line pressure</li> <li>Air flow meter</li> <li>Oxygen sensor circuits</li> <li>Oxygen sensors</li> <li>Ignition system</li> <li>ECU</li> </ul> |
| 26       |                               | Air-fuel Ratio Rich Malfunction |                                                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Injector circuit</li> <li>Injector</li> <li>Fuel line pressure</li> <li>Air flow meter</li> <li>Cold start injector</li> <li>ECU</li> </ul>                                                     |

## FAULT CODES — 1989-90 LAND CRUISER WITH 3F-E

| Code No. | Number of Check engine blinks | System                                                   | Diagnosis                                                                                                                                                | Trouble area                                                                                                                                                                                                                                                                 |
|----------|-------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28       |                               | No. 2 Oxygen Sensor Signal<br>No. 2 Oxygen Sensor Heater | Same as code No. 21                                                                                                                                      | Same as code No. 21                                                                                                                                                                                                                                                          |
| 31       |                               | Air flow Meter Signal                                    | Open circuit in VC signal or short circuit between VS and E2 when idle contacts are closed                                                               | <ul style="list-style-type: none"> <li>Air flow meter circuit</li> <li>Air flow meter</li> <li>ECU</li> </ul>                                                                                                                                                                |
| 32       |                               | Air Flow Meter Signal                                    | Open circuit in E2 or short circuit between VC and VS                                                                                                    | <ul style="list-style-type: none"> <li>Air flow meter circuit</li> <li>Air flow meter</li> <li>ECU</li> </ul>                                                                                                                                                                |
| 35       |                               | HAC Sensor Signal                                        | Open circuit in altitude compensation sensor signal                                                                                                      | <ul style="list-style-type: none"> <li>ECU</li> </ul>                                                                                                                                                                                                                        |
| 41       |                               | Throttle Position Sensor Signal                          | Open or short circuit in throttle position sensor signal                                                                                                 | <ul style="list-style-type: none"> <li>Throttle position sensor circuit</li> <li>Throttle position sensor</li> <li>ECU</li> </ul>                                                                                                                                            |
| 42       |                               | Vehicle Speed Sensor Signal                              | No "SPD" signal for 8 seconds when engine speed is between 2,000 rpm and 5,000 rpm and coolant temp. is below 80°C (176°F) except when recirc the engine | <ul style="list-style-type: none"> <li>Vehicle speed sensor circuit</li> <li>Vehicle speed sensor</li> <li>ECU</li> </ul>                                                                                                                                                    |
| 43       |                               | Starter Signal                                           | No "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moving                                                                        | <ul style="list-style-type: none"> <li>Ignition switch circuit</li> <li>Ignition switch</li> <li>ECU</li> </ul>                                                                                                                                                              |
| 71       |                               | EGR System Malfunction                                   | EGR gas temp. below predetermined level during EGR operation                                                                                             | <ul style="list-style-type: none"> <li>EGR valve</li> <li>EGR hose</li> <li>EGR gas temp. sensor circuit</li> <li>EGR gas temp. sensor</li> <li>VSV for EGR</li> <li>VSV circuit for EGR</li> <li>ECU</li> </ul>                                                             |
| 51       |                               | Switch Condition Signal                                  | No "IDL" signal, "NSW" signal or "A/C" signal to ECU, with the check terminals E1 and TET1 shorted                                                       | <ul style="list-style-type: none"> <li>A/C switch circuit</li> <li>A/C switch</li> <li>A/C amplifire</li> <li>Throttle position sensor circuit</li> <li>Throttle position sensor</li> <li>Neutral start switch</li> <li>Acceleration pedal and cable</li> <li>ECU</li> </ul> |

\* California vehicles only

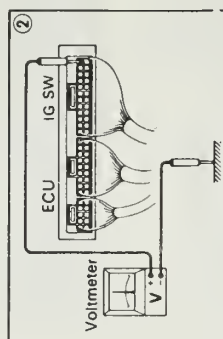
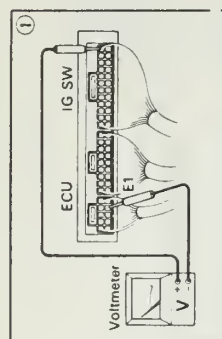
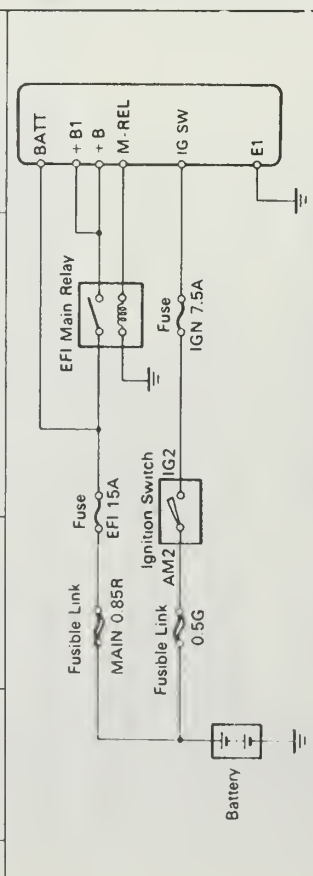




| Symbol | Terminal Name         | Symbol | Terminal Name            | Symbol | Terminal Name                              |
|--------|-----------------------|--------|--------------------------|--------|--------------------------------------------|
| E01    | ENGINE GROUND         | G1     | DISTRIBUTOR              | STP    | STOP LIGHT SWITCH                          |
| E02    | ENGINE GROUND         | VF2    | CHECK CONNECTOR          | EGR    | EGR VSV                                    |
| No 10  | INJECTOR (No 1, 2, 3) | VTA    | THROTTLE POSITION SENSOR | A/C    | A/C MAGNET SWITCH                          |
| No 20  | INJECTOR (No 4, 5, 6) | NE     | DISTRIBUTOR              | SPD    | SPEED SENSOR                               |
| HT1    | OXYGEN SENSOR HEATER  | IDL    | THROTTLE POSITION SENSOR | W      | WARNING LIGHT                              |
| HT2    | OXYGEN SENSOR HEATER  | THG    | EGR GAS TEMP SENSOR      | FPU    | FPU VSV                                    |
| STJ    | COLD START INJECTOR   | E11    | COMPUTER GROUND          | NSW    | NEUTRAL START SWITCH                       |
| E1     | COMPUTER GROUND       | OX1    | OXYGEN SENSOR            | THA    | AIR TEMP SENSOR                            |
| T      | CHECK CONNECTOR       | OX2    | OXYGEN SENSOR            | STA    | STARTER SWITCH                             |
| TWS    | WATER TEMP SWITCH     | THW    | WATER TEMP SENSOR        | VS     | AIR FLOW METER                             |
| ISC1   | ISC MOTOR No 1 COIL   | E2     | SENSOR GROUND            | AI     | AI VSV                                     |
| ISC2   | ISC MOTOR No 2 COIL   | IGF    | IGNITER                  | VC     | AIR FLOW METER or THROTTLE POSITION SENSOR |
| ISC3   | ISC MOTOR No 3 COIL   | E22    | SENSOR GROUND            | BATT   | BATTERY                                    |
| ISC4   | ISC MOTOR No 4 COIL   | IGT    | IGNITER                  | +B     | EFI MAIN RELAY                             |
| G      | DISTRIBUTOR           | 4WD    | 4WD INDICATOR            | IG SW  | IGNITION SWITCH                            |
| VFI    | CHECK CONNECTOR       | M-REL  | EFI MAIN RELAY           | +B1    | EFI MAIN RELAY                             |

\* California vehicles only

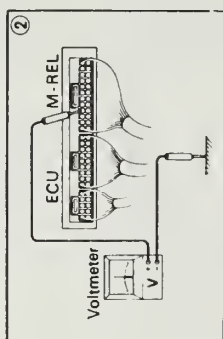
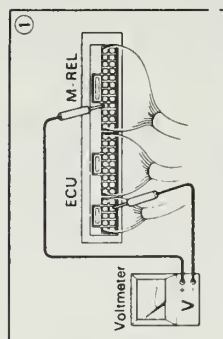
| No. | Terminals        | Trouble    | Condition          | STD Voltage |
|-----|------------------|------------|--------------------|-------------|
| 1   | BATT - E1        | No voltage | —                  | 10 - 14 V   |
|     | IG SW - E1       | No voltage | Ignition switch ON | 10 - 14 V   |
|     | M-REL - E1       | No voltage | Ignition switch ON | 10 - 14 V   |
|     | +B ( + B1 ) - E1 | No voltage | Ignition switch ON | 10 - 14 V   |



## IG SW - E1

- ```

graph TD
    Start([START]) --> Step1[① There is no voltage between ECU terminals IG S/W and E1.  
(IG SW ON)]
    Step1 --> Step2[② Check that there is voltage between ECU terminal IG S/W and body ground. (IG SW ON)]
    Step2 -- NO --> Step3[Check wiring between ECU terminal E1 and body ground.]
    Step2 -- OK --> Step4[Try another ECU.]
    Step3 -- BAD --> Step5[Replace or repair.]
    Step4 --> Step6[Check fuse, fusible link and ignition switch.]
    Step6 -- BAD --> Step7[Repair or replace.]
    Step6 --> End([END])
  
```



M-REL - E1

- ```

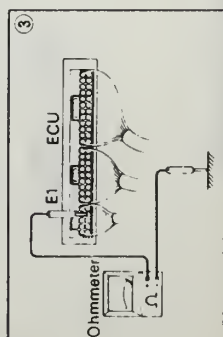
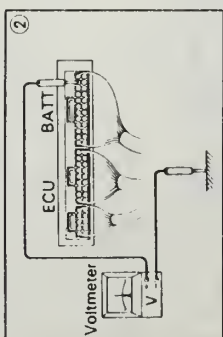
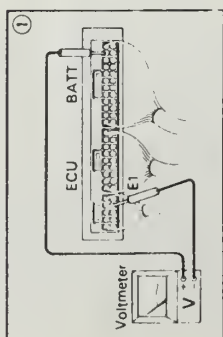
graph TD
 Start([Start]) --> Step1[① There is no voltage between ECU terminals M-REL and E1.
(IG SW ON)]
 Step1 --> Step2[② Check that there is voltage between ECU terminal M-REL
and body ground. (IG SW ON)]
 Step2 -- NO --> Step3[Check wiring between ECU terminal E1 and
body ground.]
 Step3 -- BAD --> Action1[Replace or repair.]
 Step3 -- OK --> Step4[Try another ECU]
 Step4 --> Step5[Check EFI main relay and wiring
harness.]
 Step5 -- BAD --> Action2[Replace.]
 Step5 -- OK --> Step6[Try another ECU]
 Step6 --> End([End])

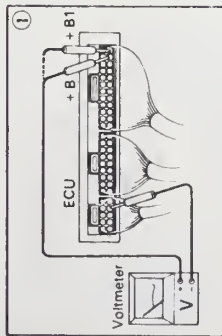
```

• BATT - E1

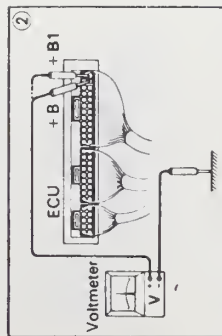
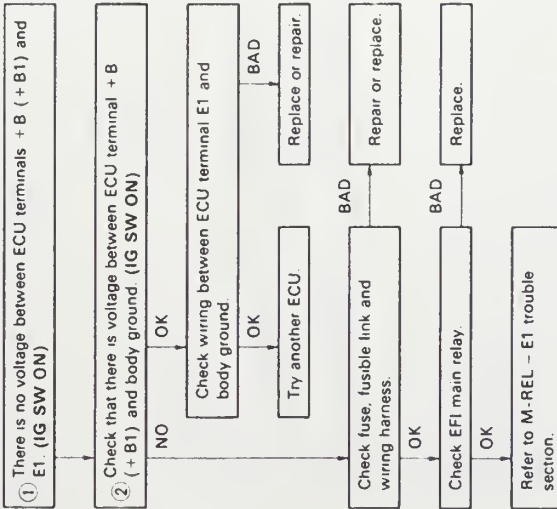
- ```

graph TD
    Start([Start]) --> Step1[① There is no voltage between ECU terminals BATT and E1.]
    Step1 --> Step2[② Check that there is voltage between ECU terminal BATT and body ground.]
    Step2 -- NO --> Step1
    Step2 -- OK --> Step3[③ Check wiring between ECU terminal E1 and body ground.]
    Step3 -- OK --> TryECU[Try another ECU.]
    Step3 -- BAD --> RepairECU[Repair or replace.]
    TryECU --> Step4[Check fuse and fusible link.]
    Step4 -- BAD --> Replace[Replace.]
    Step4 -- OK --> Step5[Check wiring between ECU terminal and battery.]
    Step5 -- BAD --> RepairBattery[Repair or replace.]
    Step5 -- OK --> End([End])
  
```

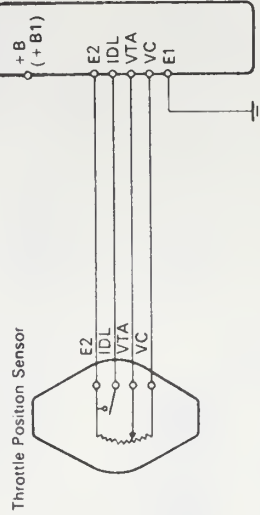




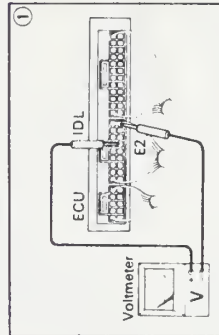
• +B (+B1) - E1



No.	Terminals	Trouble	Condition	STD Voltage
2	IDL - E2	No voltage	Ignition switch ON	4 - 6 V
	VC - E2			4 - 6 V
	VTA - E2		Throttle valve fully open	0.1 - 1.0 V
			Throttle valve fully open	4 - 5 V

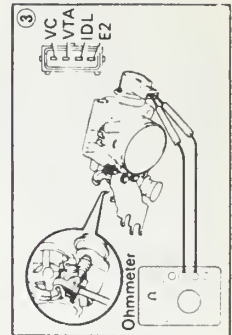
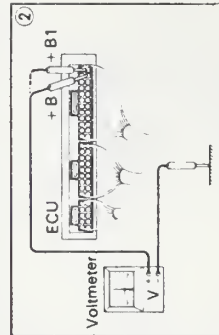
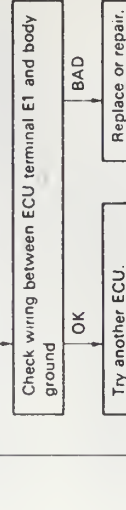


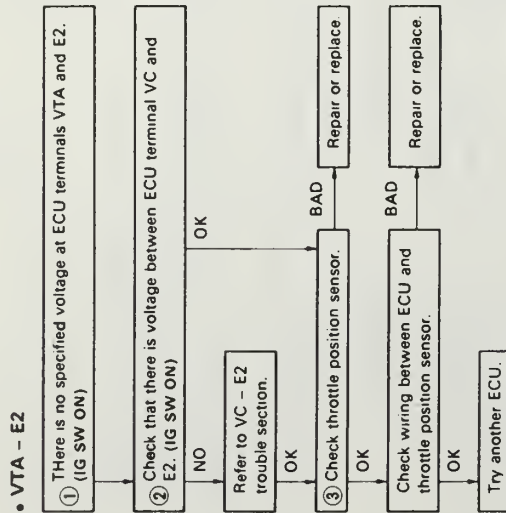
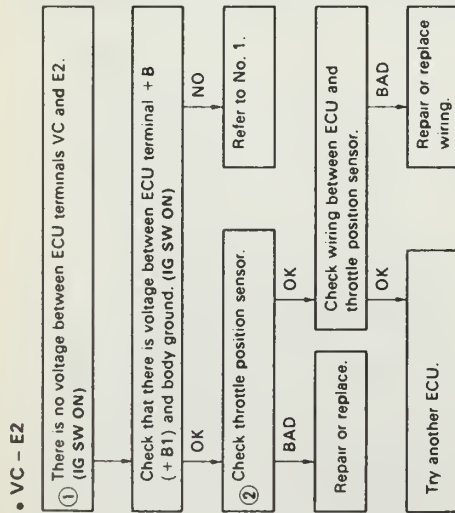
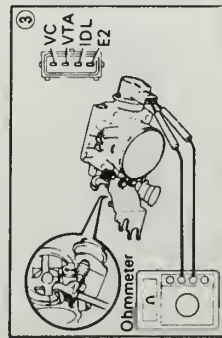
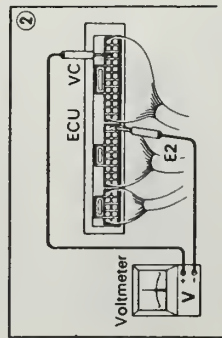
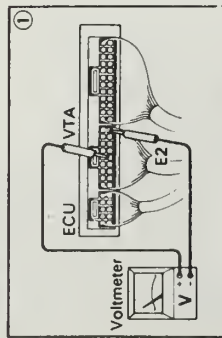
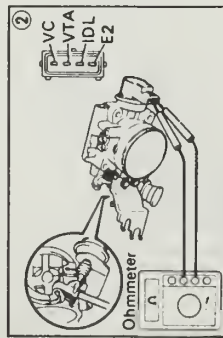
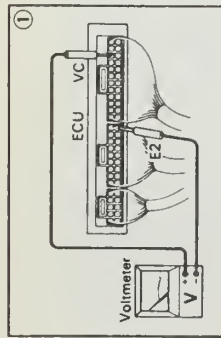
• IDL - E2



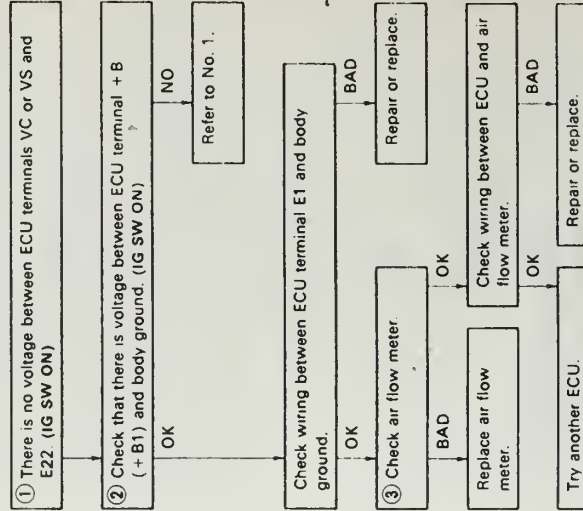
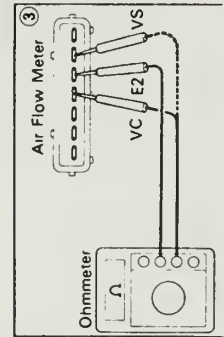
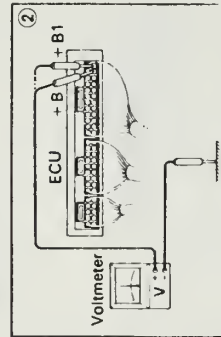
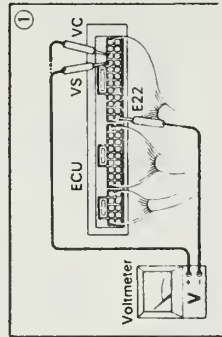
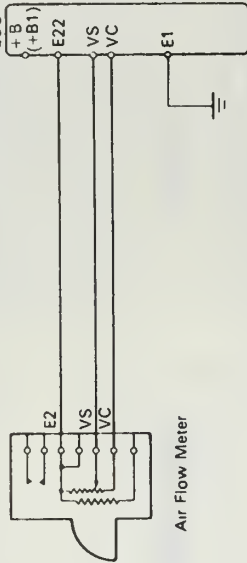
1 There is no voltage between ECU terminals IDL and E2 (IG SW ON). (Throttle valve open)

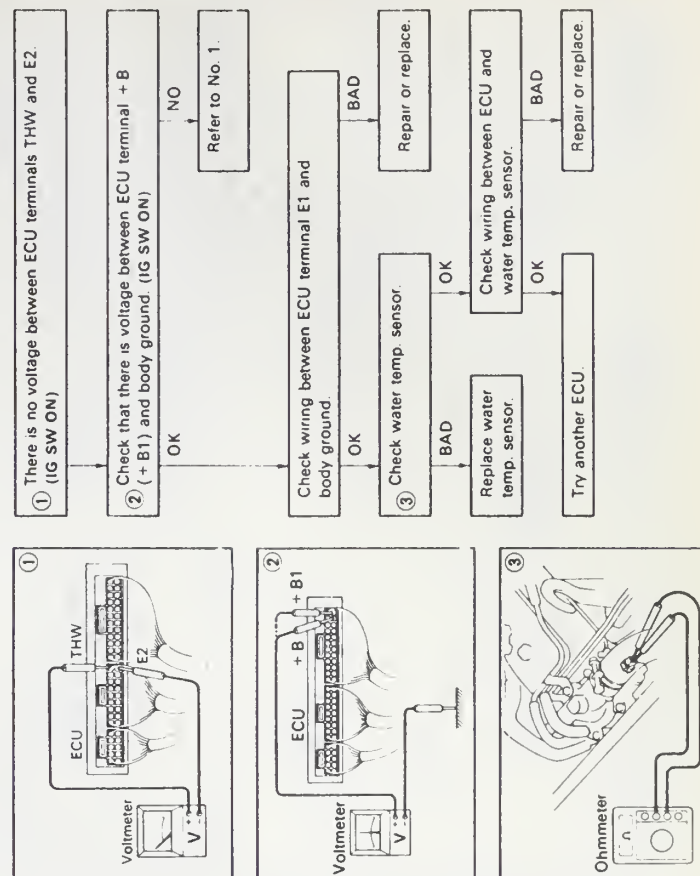
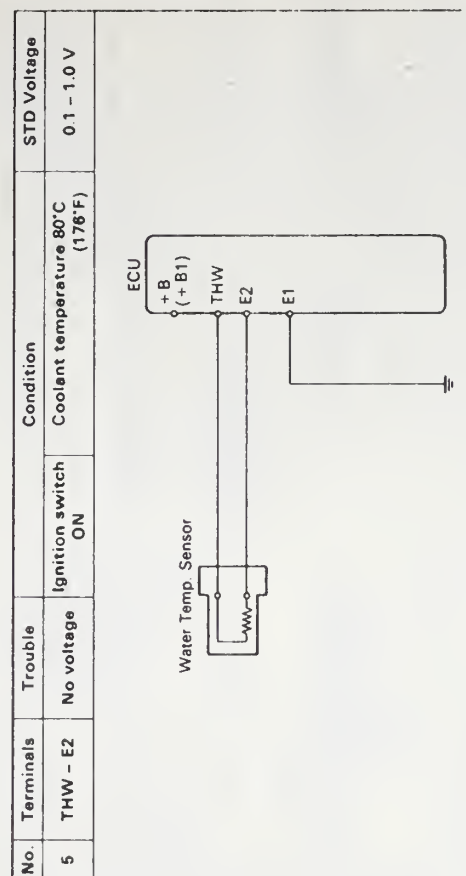
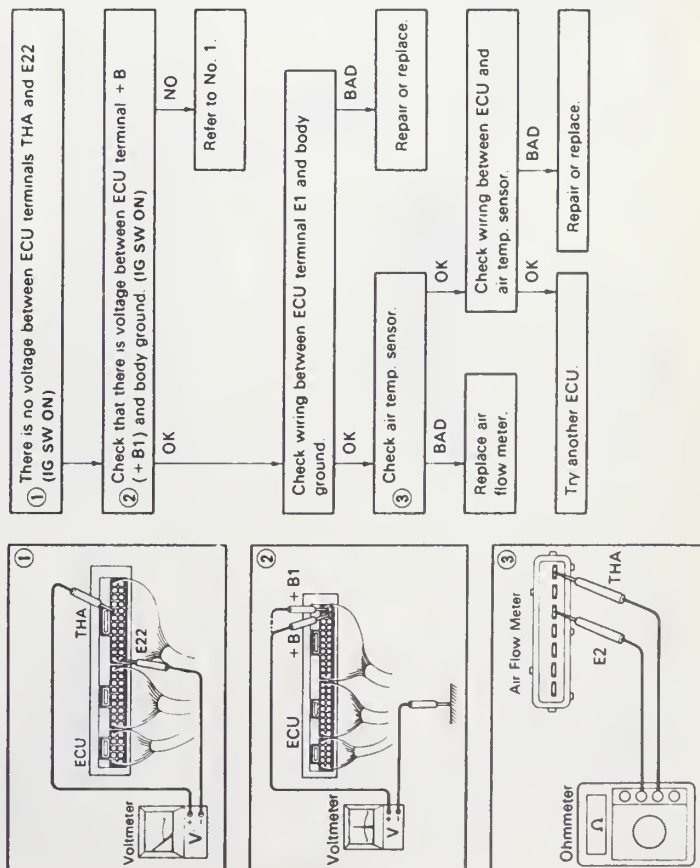
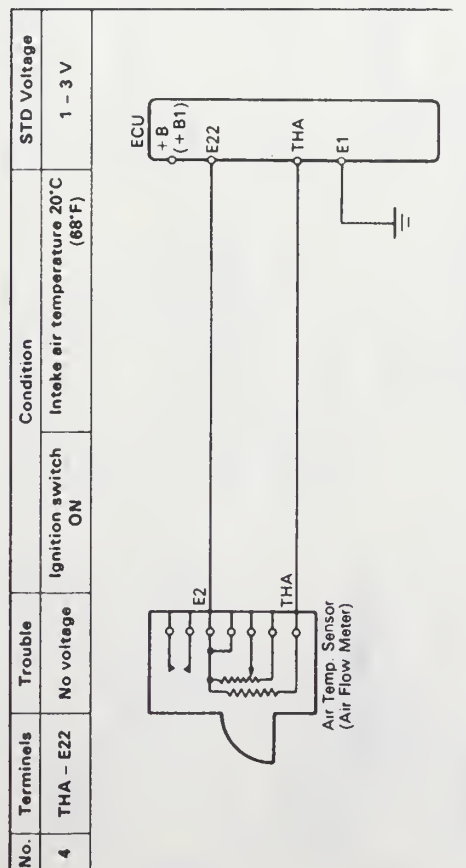
2 Check that there is voltage between ECU terminal +B (+B1) and body ground (IG SW ON)



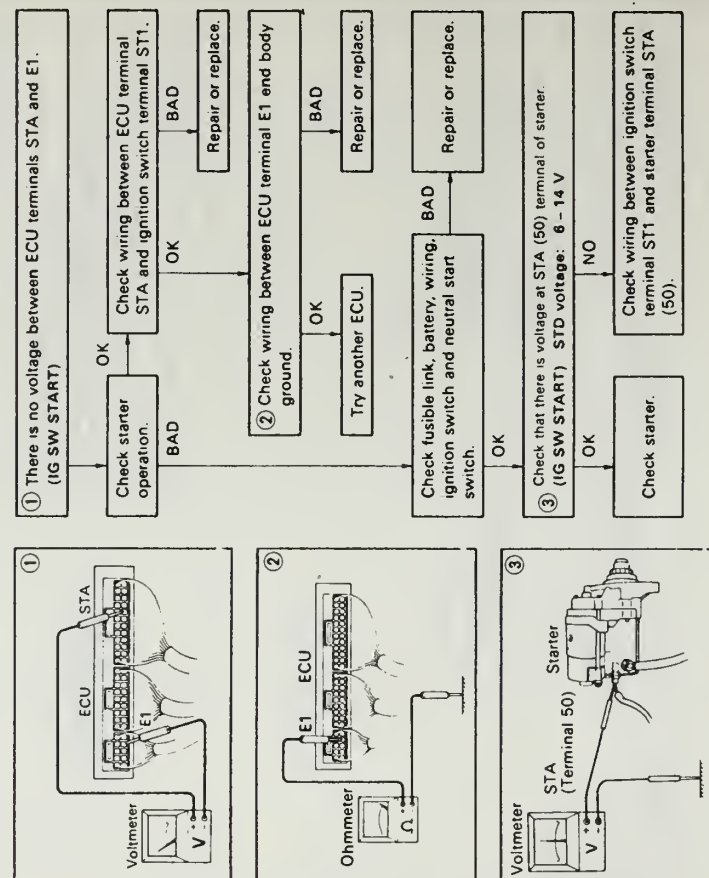
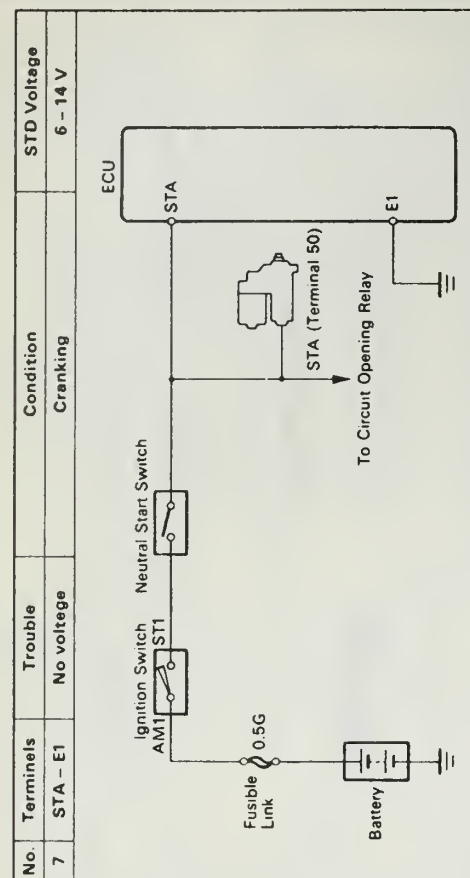
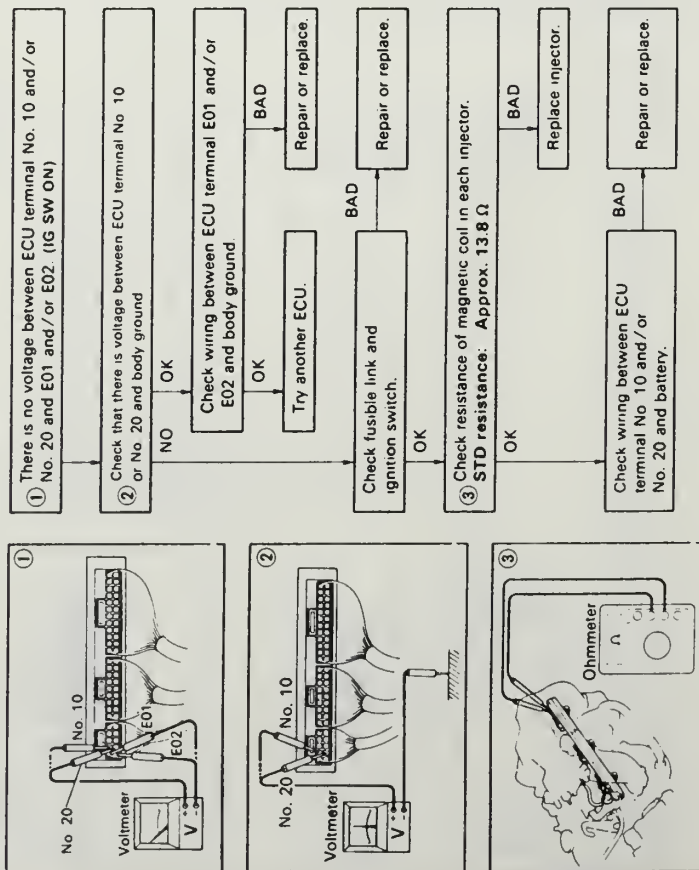
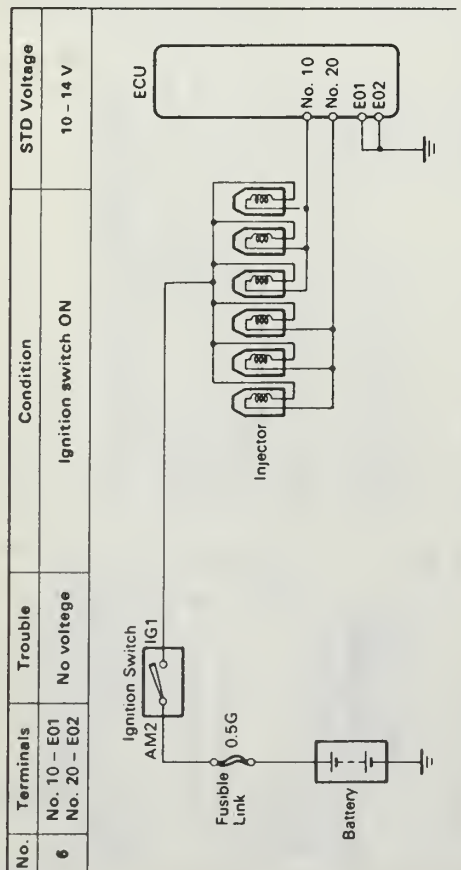


No.	Terminals	Trouble	Condition	STD Voltage
3	VC - E22	No voltage	Ignition switch ON	4 - 6 V
	VS - E22			4 - 5 V
	VS - E22			0.02 - 0.08 V
	VS - E22			2 - 4 V
	VS - E22			0.3 - 1.0 V



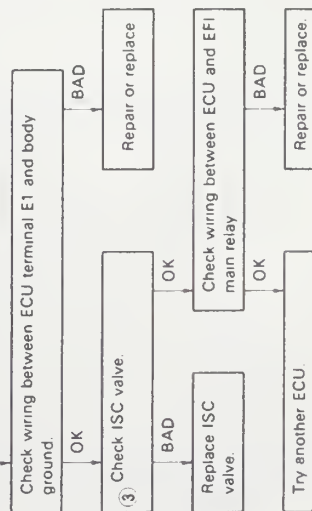
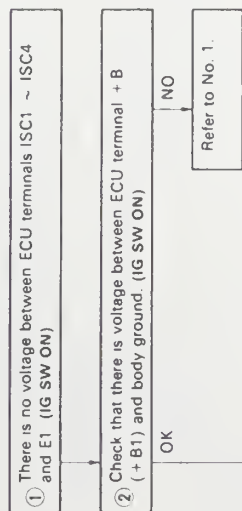
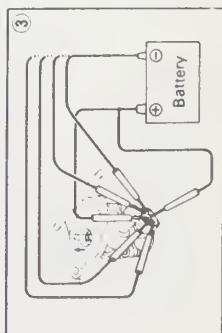
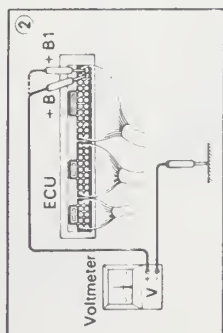
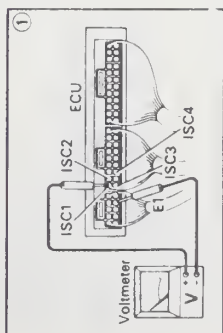
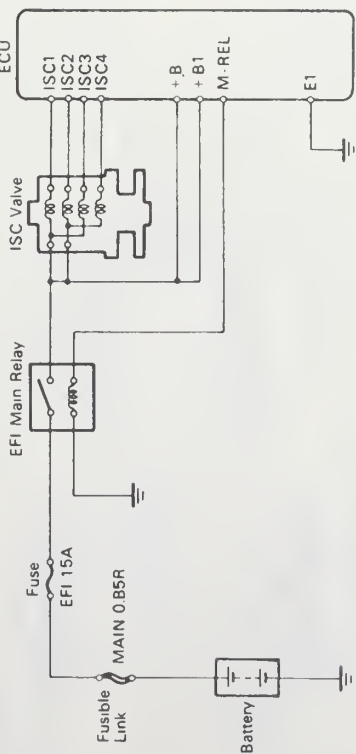


5 FUEL SYSTEM



No.	Terminals	Trouble	Condition	STD Voltage
8	ISC1 ~ ISC4 - E1	No voltage	Ignition switch ON	10 - 14 V

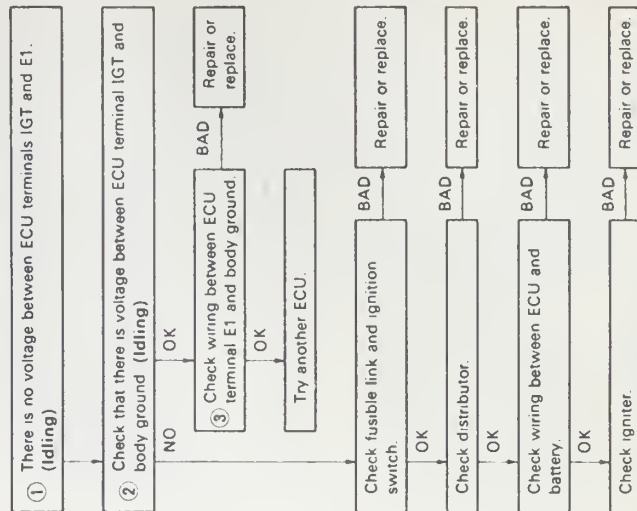
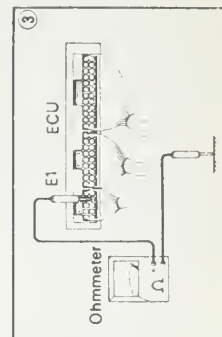
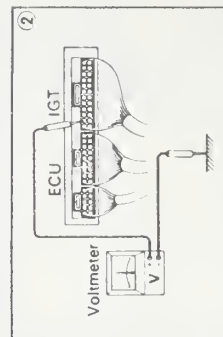
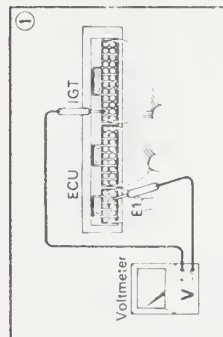
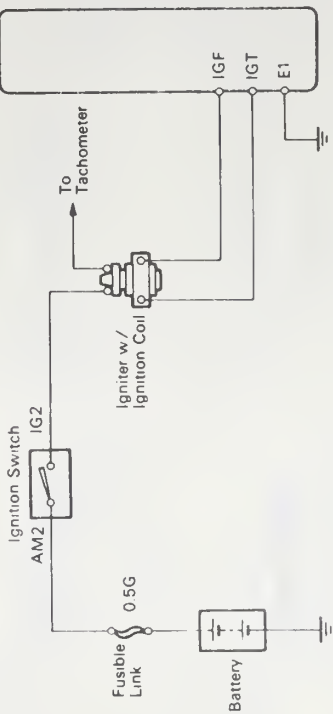
The diagram illustrates the electrical circuit for the ISC1 ~ ISC4 - E1 terminals. The power source is the Battery, which is connected to a Fusible Link and then to a 15A Fuse. The output of the fuse leads to the EFI Main Relay. The relay's output is connected to the ISC Valve. The ISC Valve has four terminals (ISC1, ISC2, ISC3, ISC4) connected to the ECU. The ECU also has terminals for +B, +B1, M-REL, and E1. The E1 terminal is grounded.



No	Terminals	Trouble	Condition	STD Voltage
9	IGT - E1	No voltage	Idling	0.7 - 1.0 V

Wiring diagram for Igniter w/ Ignition Coil:

- Battery is connected to a fusible link (0.5G).
- The fusible link is connected to the AM2 terminal of the Ignition Switch.
- The Ignition Switch has terminals IG2 and AM2.
- The Igniter w/ Ignition Coil has terminals IGF, IGT, and E1.
- The IGF terminal of the Igniter is connected to the tachometer (To Tachometer).
- The IGT terminal of the Igniter is connected to the ECU.
- The ECU has terminals IGF, IGT, and E1.
- The E1 terminal of the Igniter is connected to ground.



5 FUEL SYSTEM

No.	Terminals	Trouble	Condition	STD Voltage
10	W - E1	No voltage	No trouble ("CHECK" engine warning light off) and engine running	10 - 14 V

① There is no voltage between ECU terminals W and E1.
(Idling)

② Check that there is voltage between ECU terminal W and body ground.

NO → ③ Check wiring between ECU terminal E1 and body ground.

OK → Try another ECU.

Check GAUGE fuse (7.5A) and "CHECK" engine warning light.

OK → Fuse blows again → Repair or replace.

BAD → Repair or replace.

Check wiring between ECU terminal W and fuse.

OK → Repair or replace.

BAD → Repair or replace.

①

②

③

No.	Terminals	Trouble	Condition	STD Voltage
11	A/C - E1	No voltage	Air conditioning ON	10 - 14 V

① There is no voltage between ECU terminals A/C and E1.
(Air conditioning ON)

② Check that there is voltage between ECU terminal A/C and body ground.

NO → ③ Check wiring between ECU terminal E1 and body ground.

OK → Try another ECU.

Check compressor running.

OK → Check wiring between ECU terminal A/C and amplifier.

BAD → Repair or replace.

BAD → Check that there is voltage between amplifier terminal and body ground.

OK → Check wiring between amplifier and ECU or compressor.

BAD → Repair or replace.

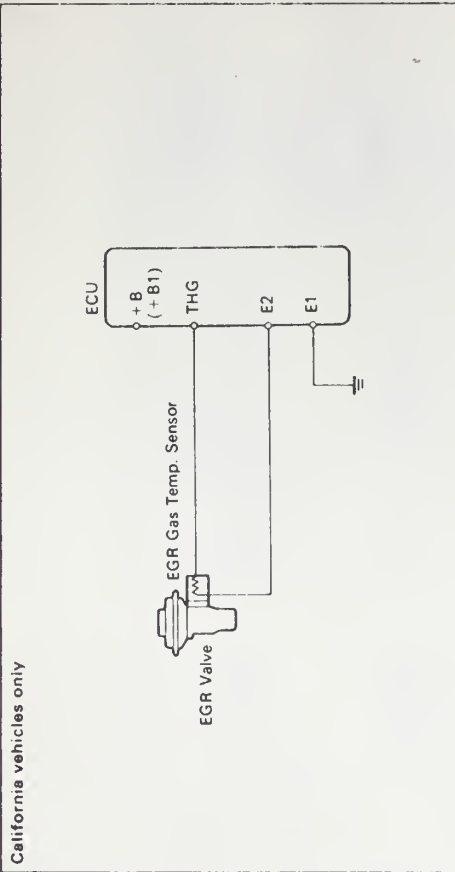
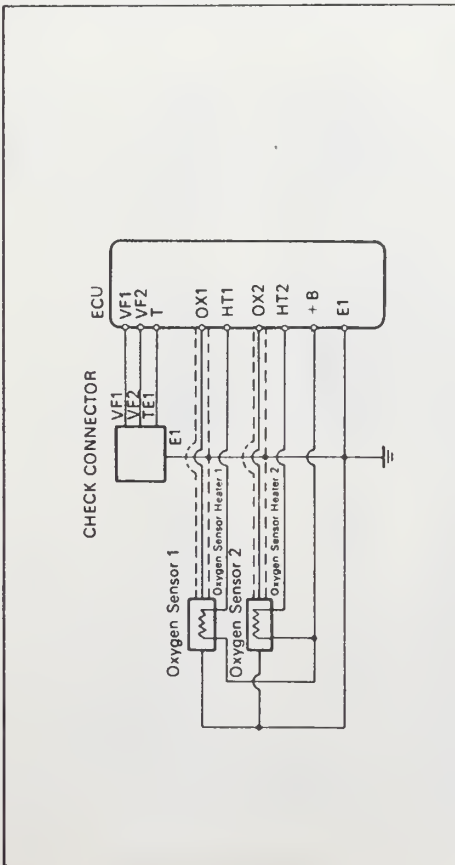
①

②

③

OXYGEN SENSOR TESTS – **1989–90 CALIFORNIA LAND CRUISER WITH 3F-E**

EGR GAS TEMPERATURE SENSOR – **1989–90 CALIFORNIA LAND CRUISER WITH 3F-E**



Oxygen Sensor Tests – 1989–90 California Land Cruiser with 3F-E

1 There is no voltage between ECU terminals VF1 or VF2 and E1

Check that there is specified voltage between ECU terminal VF1 or VF2 and body ground

NO → Check for suction of air into exhaust system. → Repair air suction system.

OK → Check for air leak from air intake system. → Repair air leak.

Check spark plugs → Repair or replace.

Check distributor and ignition system → Repair or replace.

Check fuel pressure → Repair or replace.

Check injectors → Repair or replace.

Check cold start injector. * → Repair or replace.

Check air flow meter → Repair or replace.

2 Check operation of oxygen sensors

OK → System normal.

BAD → Check wiring between oxygen sensors and ECU connectors → Repair wiring.

Replace oxygen sensors

* Rich malfunction only

EGR Gas Temperature Sensor – 1989–90 California Land Cruiser with 3F-E

1 No voltage between ECU terminals THG and E2

Check that there is voltage between ECU terminal +B (+B1) and body ground (IG SW ON)

OK → Check wiring between ECU terminal E1 and body ground. → Repair or replace.

BAD → Check EGR system. → Repair or replace.

3 Check EGR gas temp. sensor.

OK → Check wiring between ECU and EGR gas temp. sensor. → Repair or replace.

BAD → Replace EGR gas temp. sensor. → Try another ECU.

FAULT CODES -- 1991 LAND CRUISER WITH 3F-E

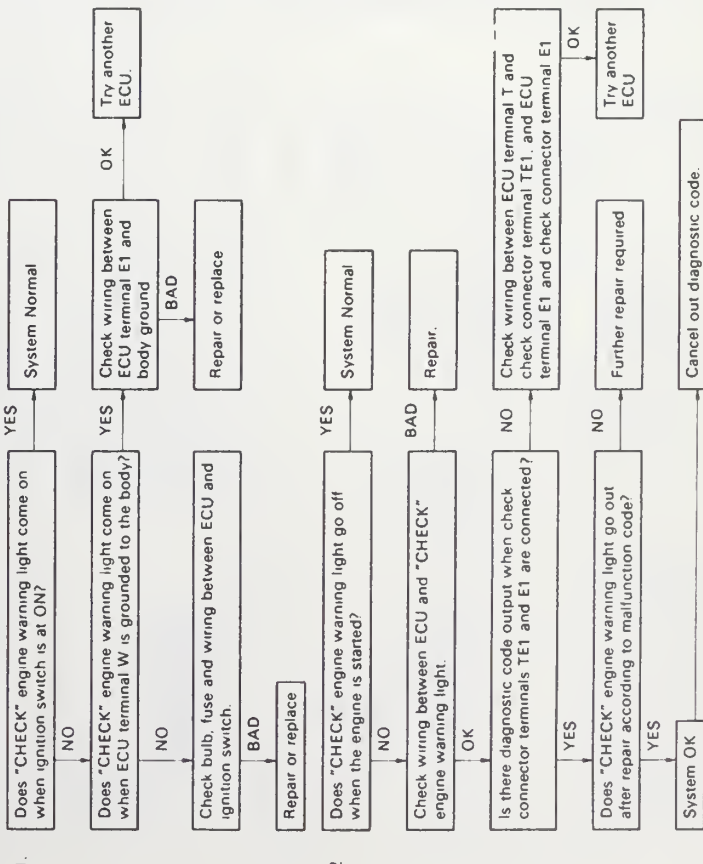
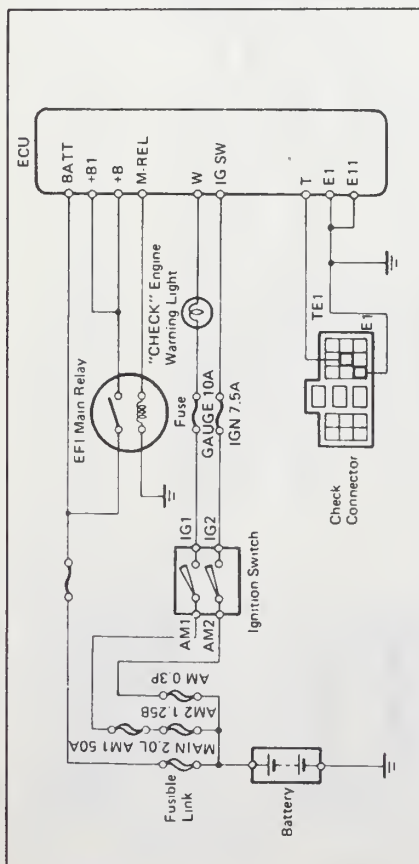
Code No.	Number of Check engine blinks	System	Diagnosis	Trouble area
—		Normal	This appears when none of the other codes are identified	—
12		RPM Signal	No "NE" or "G" signal to ECU within 2 seconds after engine has been cranked	- Distributor circuit - Distributor - Starter signal circuit - ECU
13		RPM Signal	No "NE" signal to ECU when engine speed is above 1,000 rpm	- Distributor circuit - Distributor - ECU
14		Ignition Signal	No "IGF" signal to ECU 6 - 8 times in succession	- Igniter and ignition coil circuit - Igniter and ignition coil - ECU
21		Oxygen Sensor Signal	During air-fuel ratio feedback correction, voltage output from the oxygen sensor does not exceed a set value on the lean side and the rich side continuously for a certain period	- Oxygen sensor circuit - Oxygen sensor - ECU
22		Water Temp Sensor Signal	Open or short circuit in water temp sensor signal	- Oxygen sensor heater circuit - Oxygen sensor heater - ECU
24		Intake Air Temp Sensor Signal	Open or short circuit in intake air temp sensor signal	- Water temp sensor circuit - Water temp sensor - ECU
25		Air-fuel Ratio Lean Malfunction	(1) When air-fuel ratio feedback compensation value or adaptive control value continues at the upper (lean) or lower (rich) limit (2) When air-fuel ratio feedback compensation value or adaptive control value feedback frequency is abnormally high during feedback condition	- Intake air temp sensor circuit - Intake air temp sensor - ECU
26		Air-fuel Ratio Rich Malfunction	HINT For condition (2), neither a lean (Code No. 25) nor a rich (Code No. 26) diagnosis is displayed consecutively	- Injector circuit - Injector - Fuel line pressure - Air flow meter - Air induction system - Oxygen sensor circuits - Oxygen sensors - Ignition system - ECU

FAULT CODES -- 1991 LAND CRUISER WITH 3F-E

Code No.	Number of Check engine blinks	System	Diagnosis	Trouble area
28		No. 2 Oxygen Sensor Signal No. 2 Oxygen Sensor Heater	Same as code No. 21	Same as code No. 21
31		Air flow Meter Signal	Open circuit in VC and VS signal of short circuit between VS and E2 when idle contacts are closed.	- Air flow meter circuit - Air flow meter - ECU
32		Air Flow Meter Signal	Open circuit in E2 or short circuit between VC and VS	- Air flow meter circuit - Air flow meter - ECU
35		HAC Sensor Signal	Open circuit in altitude compensation sensor signal.	ECU
41		Throttle Position Sensor Signal	Open or short circuit in throttle position sensor signal	- Throttle position sensor circuit - Throttle position sensor - ECU
42		Vehicle Speed Sensor Signal	No "SPD" signal for 8 seconds when engine speed is between 2,000 rpm and 5,000 rpm and coolant temp. is below 80°C (176°F) except when racing the engine	- Vehicle speed sensor circuit - Vehicle speed sensor - ECU
43		Starter Signal	No "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moving	- Ignition switch circuit - Ignition switch - ECU
71		EGR System Malfunction	EGR gas temp. below predetermined level during EGR operation	- EGR valve - EGR hose - EGR gas temp. sensor circuit - EGR gas temp. sensor - VSV for EGR - VSV circuit for EGR - ECU
51		Switch Condition Signal	No "IDL" signal, "NSW" signal or "A/C" signal to ECU, with the check terminals ET and TE1 connected.	- A/C switch circuit - A/C switch - A/C amplifier - Throttle position sensor circuit - Throttle position sensor - Neutral start switch - Neutral start switch - Acceleration pedal and cable - ECU

* California vehicles only

TESTING THE ECU DIAGNOSTIC CIRCUIT -- 1991 LAND CRUISER WITH 3F-E

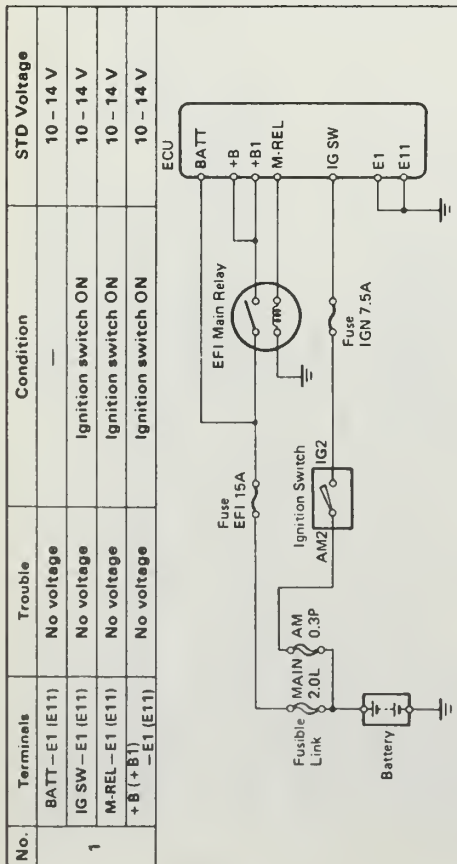


ECU TERMINALS -- 1991 LAND CRUISER WITH 3F-E

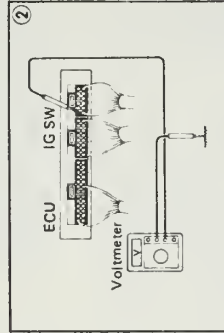
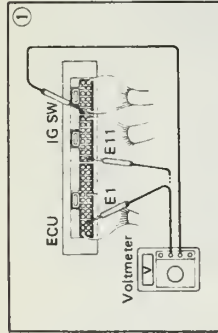
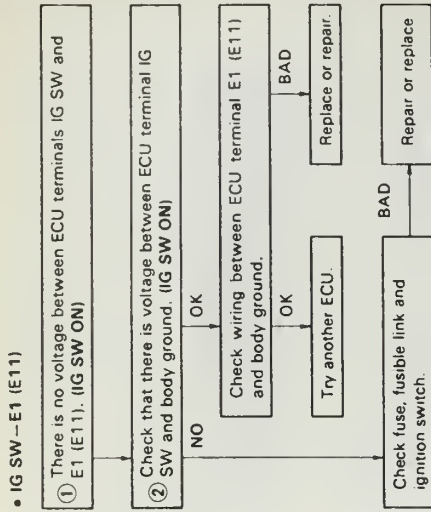
Symbol	Terminal Name	Symbol	Terminal Name	Symbol	Terminal Name
E01	ENGINE GROUND	G -	DISTRIBUTOR	M-REL	EFI MAIN RELAY
E02	ENGINE GROUND	IGF	IGNITER	THA	AIR TEMP. SENSOR
No. 10	INJECTOR (No. 1, 2, 3)	EGR	EGR VSV	VS	AIR FLOW METER
No. 20	INJECTOR (No. 4, 5, 6)	STA	STARTER SWITCH	VTA	THROTTLE POSITION SENSOR
STJ	COLD START INJECTOR	NSW	NEUTRAL START SWITCH	VC	AIR FLOW METER or THROTTLE POSITION SENSOR
E1	COMPUTER GROUND	HT2	OXYGEN SENSOR HEATER	E2	SENSOR GROUND
ISC1	ISC MOTOR No. 1 COIL	HT1	OXYGEN SENSOR HEATER	IG SW	IGNITION SWITCH
A1	AI VSV	VFI	CHECK CONNECTOR	4WD	CENTER DIFFLOCK INDICATOR
ISC2	ISC MOTOR No. 2 COIL	E11	COMPUTER GROUND	STP	STOP LIGHT SWITCH
IGT	IGNITER	VF2	CHECK CONNECTOR	SPD	SPEED SENSOR
ISC3	ISC MOTOR No. 3 COIL	T	CHECK CONNECTOR	A/C	A/C MAGNET SWITCH
TWS	WATER TEMP. SWITCH	OX1	OXYGEN SENSOR	BATT	BATTERY
ISC4	ISC MOTOR No. 4 COIL	OX2	OXYGEN SENSOR	W	WARNING LIGHT
FPU	FPU VSV	*THG	EGR GAS TEMP. SENSOR	+B	EFI MAIN RELAY
G1	DISTRIBUTOR	THW	WATER TEMP. SENSOR	+B1	EFI MAIN RELAY
NE	DISTRIBUTOR	IDL	THROTTLE POSITION SENSOR		



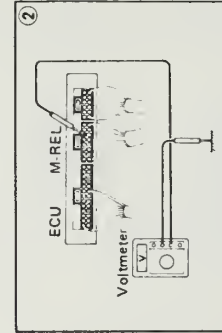
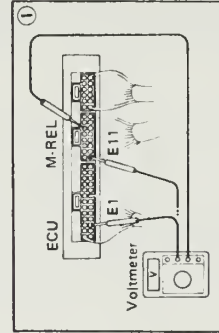
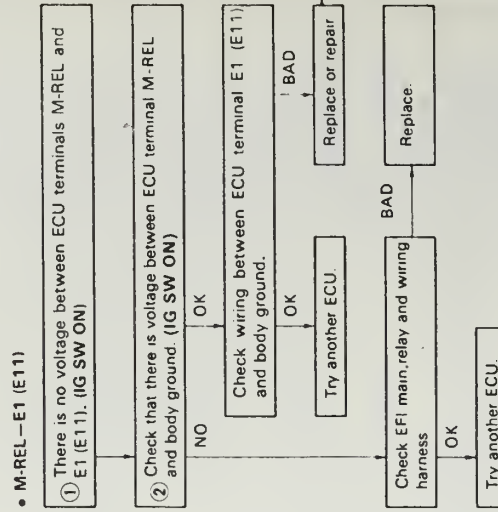
*California vehicles only



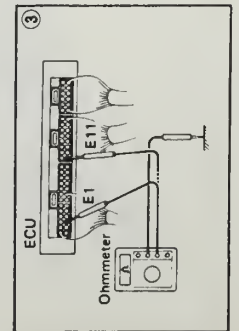
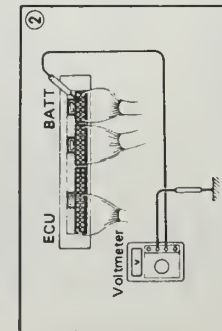
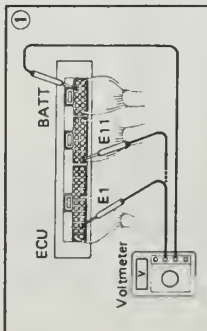
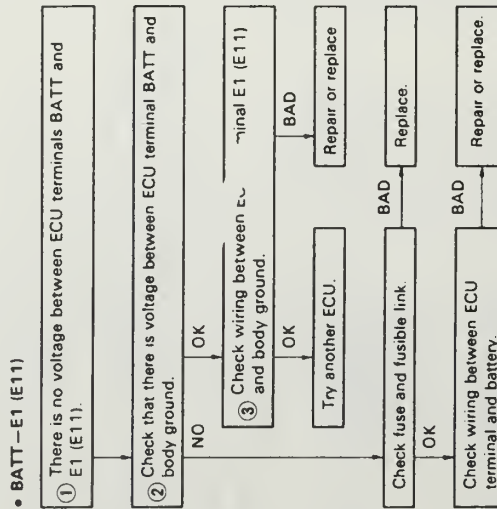
• IG SW—E1 (E11)



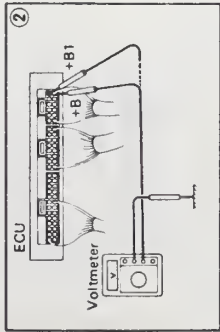
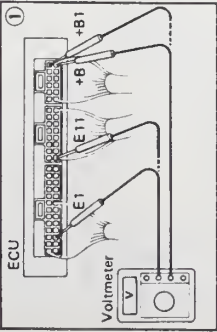
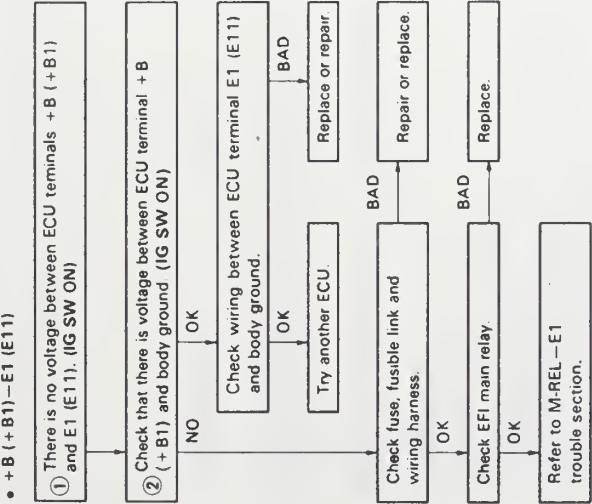
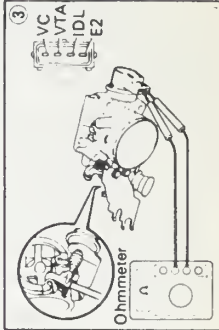
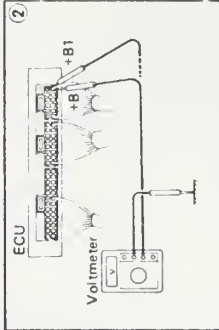
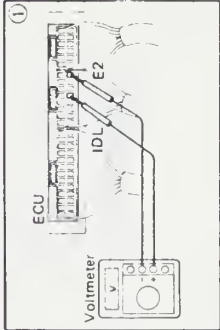
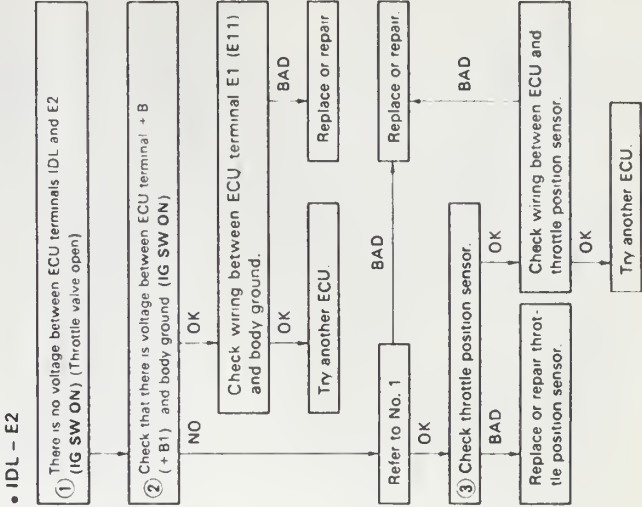
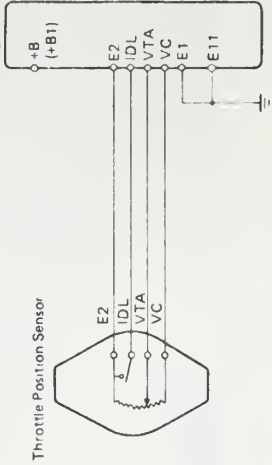
• M-REL—E1 (E11)



• BATT—E1 (E11)

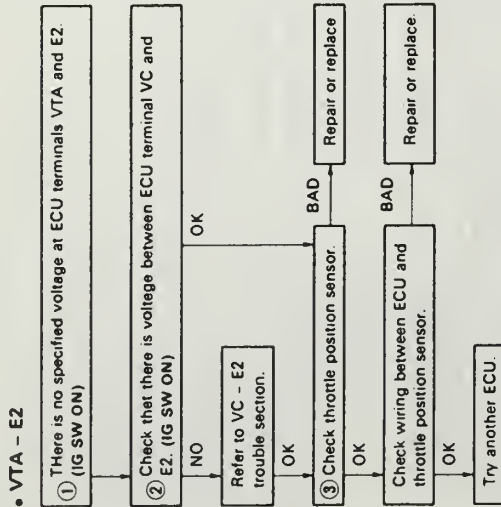
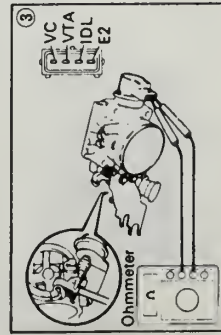
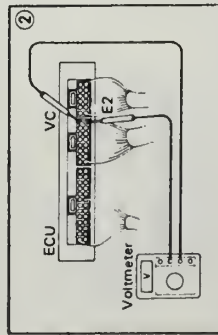
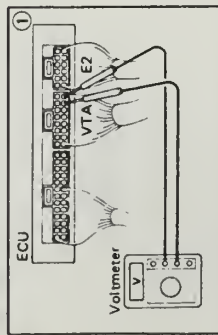
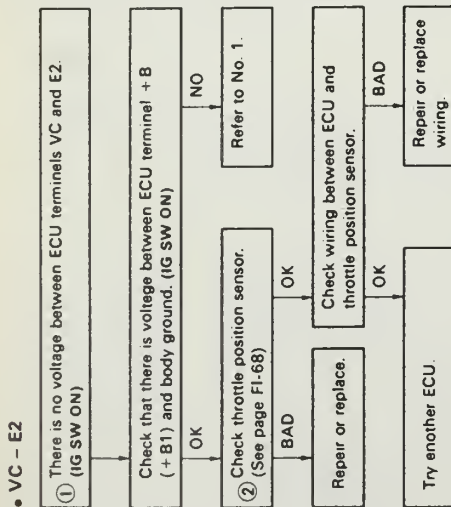
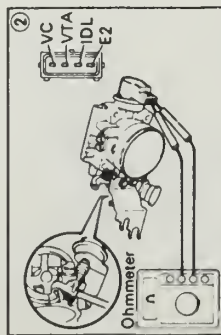
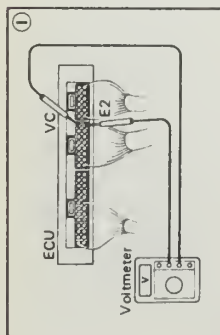


No.	Terminals	Trouble	Condition	STD Voltage
2	IDL – E2	No voltage	Ignition switch ON	4 – 6 V
	VC – E2			4 – 6 V
	VTA – E2			0.1 – 1.0 V
			Throttle valve fully closed	3 – 5 V
			Throttle valve fully open	

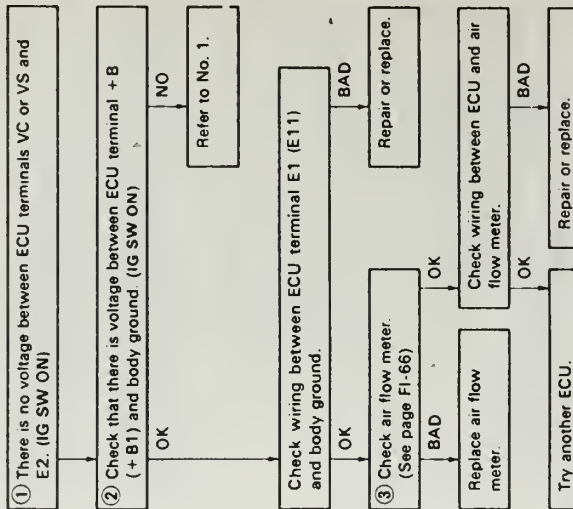
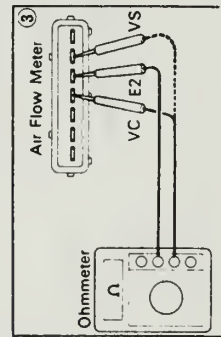
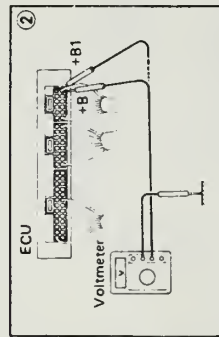
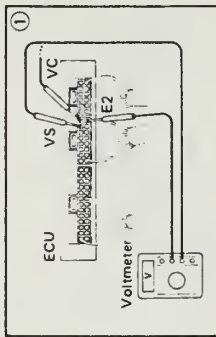
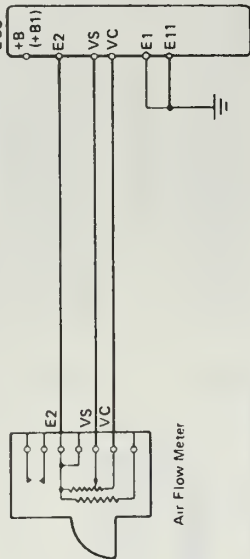


ECU TEST NO.2: (CONTINUED)

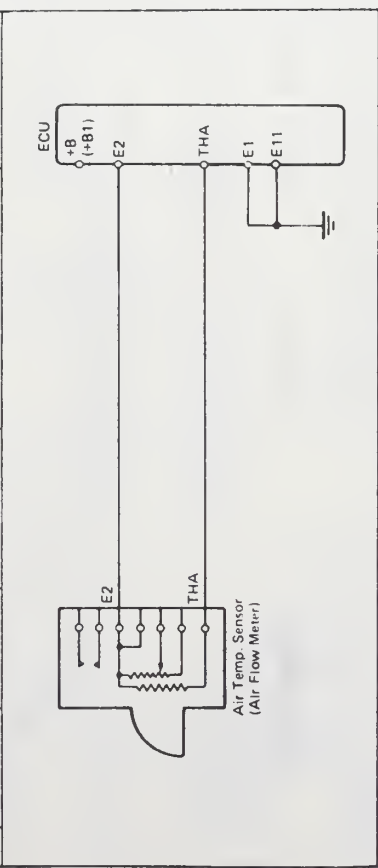
ECU TEST NO.3 – 1991 LAND CRUISER WITH 3F-E



No.	Terminals	Trouble	Condition	STD Voltage
3	VC – E2	No voltage	Ignition switch ON	4 – 6 V
	VS – E2		Measuring plate fully closed	4 – 5 V
	VS – E2		Measuring plate fully open	0.02 – 0.08 V
	VS – E2		Idling	2 – 4 V
	VS – E2		3,000 rpm	0.3 – 1.0 V



No.	Terminals	Trouble	Condition	STD Voltage
4	THA — E2	No voltage	Intake air temperature 20°C (68°F) Ignition switch ON	1 — 3 V



① There is no voltage between ECU terminals THA and E2.

② Check that there is voltage between ECU terminal + B (+ B1) and body ground. (IG SW ON)

Check wiring between ECU terminal E1 (E11) and body ground.

Check air temp sensor.

Replace air flow meter.

Try another ECU

Repair or replace.

①

THA

ECU

Voltmeter

②

+B1

+B

ECU

Voltmeter

③

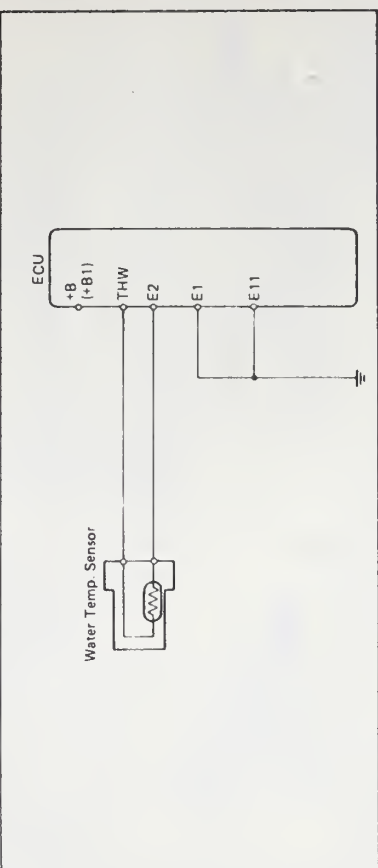
Air Flow Meter

E2

THA

Ohmmeter

No.	Terminals	Trouble	Condition	STD Voltage
5	THW — E2	No voltage	Coolant temperature 80°C (176°F) Ignition switch ON	0.1 — 1.0 V



① There is no voltage between ECU terminals THW and E2.

② Check that there is voltage between ECU terminal + B (+ B1) and body ground. (IG SW ON)

Check wiring between ECU terminal E1 (E11) and body ground.

Check water temp. sensor.

Replace water temp. sensor.

Try another ECU

Repair or replace.

①

THW

ECU

Voltmeter

②

+B1

+B

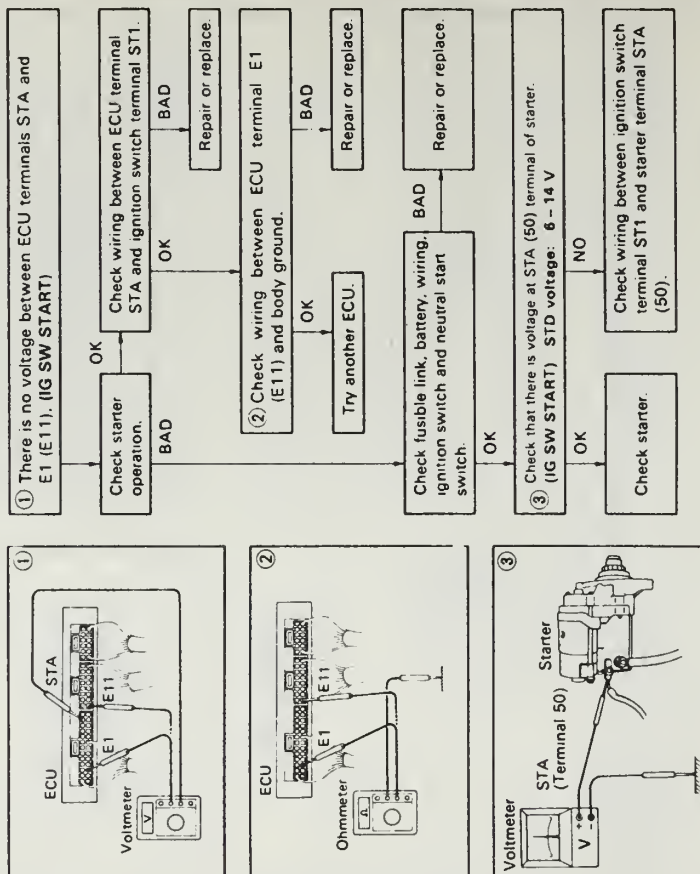
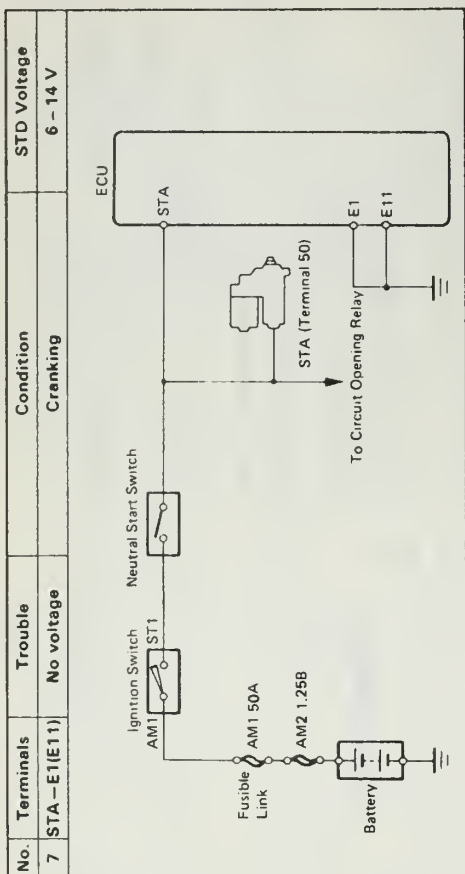
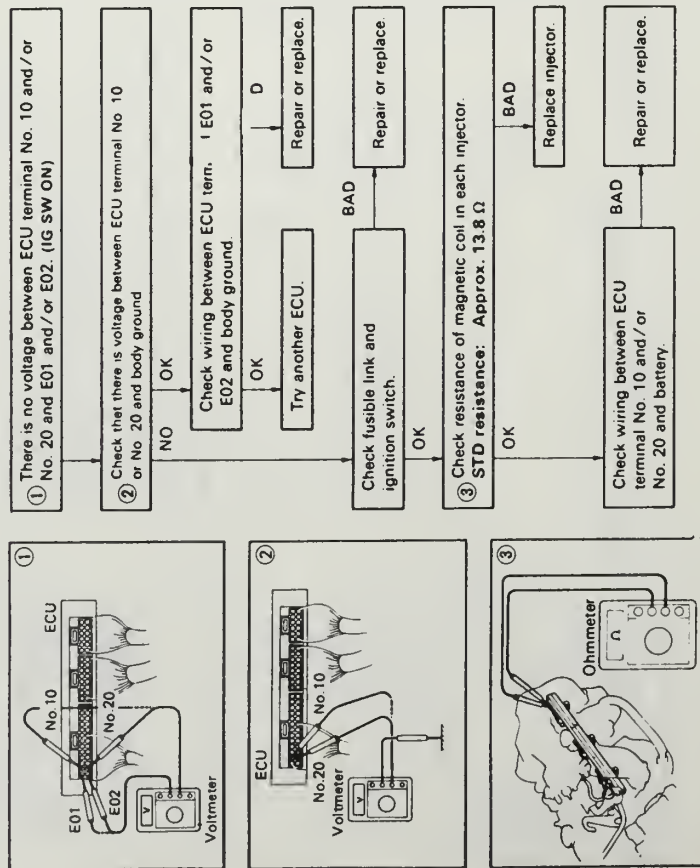
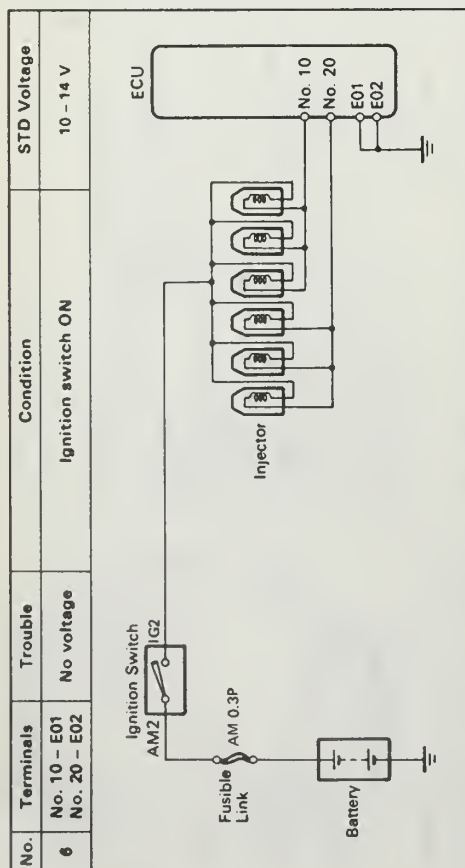
ECU

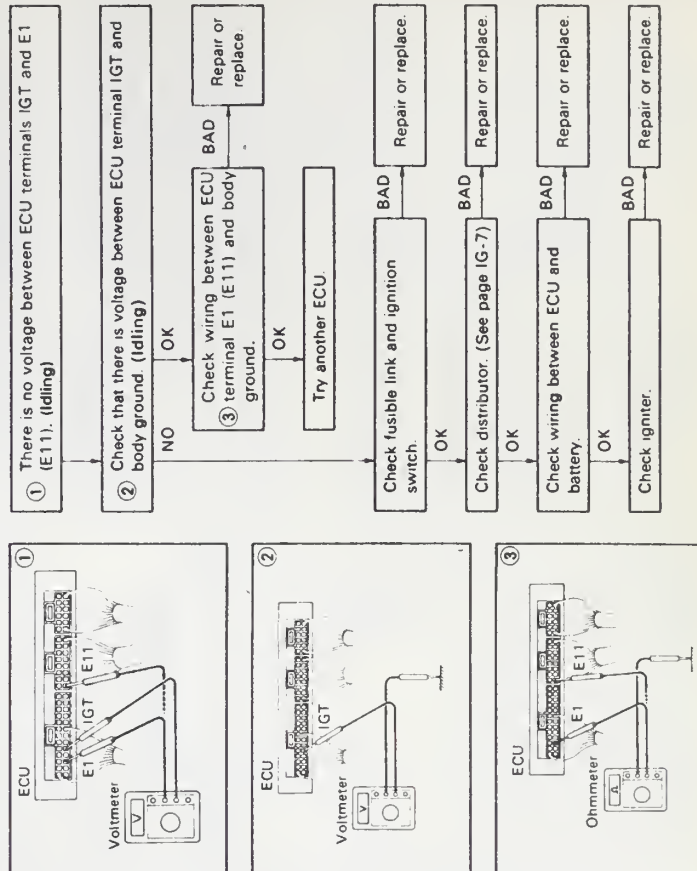
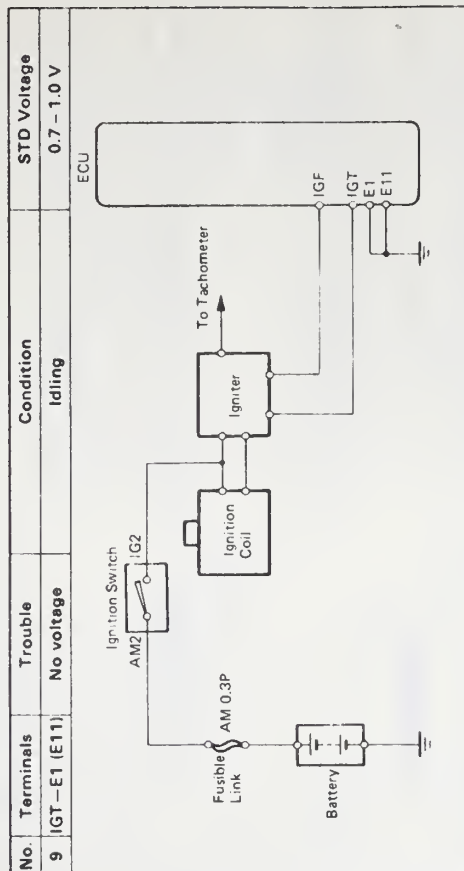
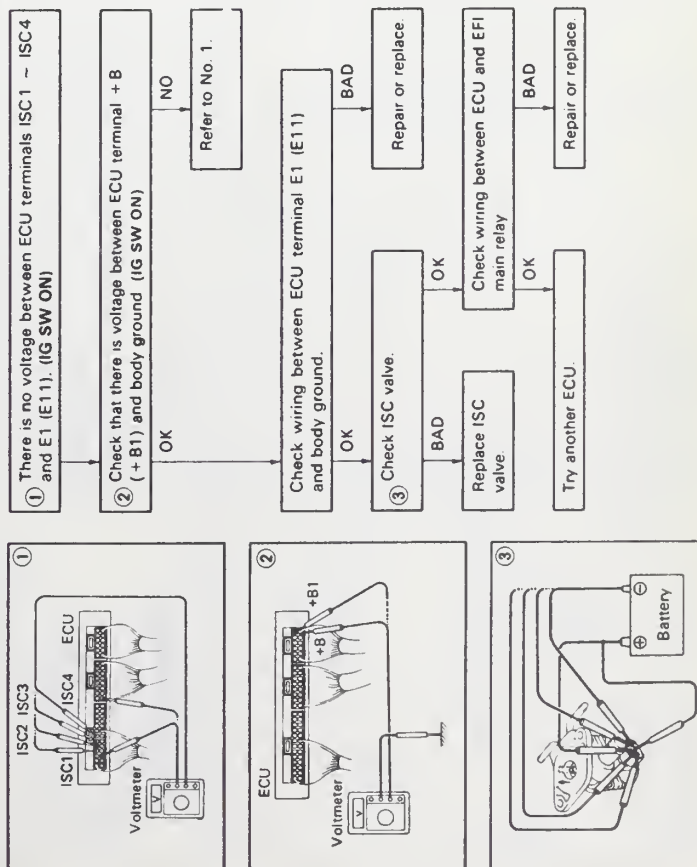
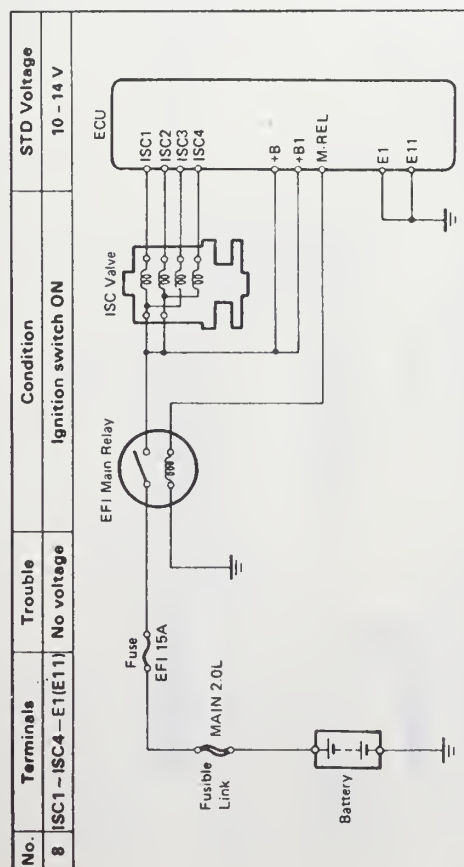
Voltmeter

③

Ohmmeter

5 FUEL SYSTEM





No.	Terminals	Trouble	Condition	STD Voltage
10	W-E1 (E11)	No voltage	No trouble ("CHECK" engine warning light off) and engine running	10 - 14 V

① There is no voltage between ECU terminals W and E1 (E11). (Idling)

② Check that there is voltage between ECU terminal W and body ground.

NO → OK → Check GAUGE fuse (10A) and "CHECK" engine warning light.

OK → Check wiring between ECU terminal W and fuse. → BAD → Repair or replace.

OK → Try another ECU → OK → Check GAUGE fuse (10A) and "CHECK" engine warning light. → OK → Fuse blows again → Repair or replace.

OK → Check wiring between ECU terminal W and fuse. → BAD → Repair or replace.

③ Check wiring between ECU terminal E1 (E11) and body ground.

NO → OK → Check wiring between ECU terminal W and body ground. → OK → Try another ECU → OK → Check GAUGE fuse (10A) and "CHECK" engine warning light. → OK → Fuse blows again → Repair or replace.

NO → OK → Check wiring between ECU terminal W and body ground. → OK → Try another ECU → OK → Check GAUGE fuse (10A) and "CHECK" engine warning light. → OK → Fuse blows again → Repair or replace.

④ Check wiring between ECU terminal E1 (E11) and body ground.

NO → OK → Check wiring between ECU terminal W and body ground. → OK → Try another ECU → OK → Check GAUGE fuse (10A) and "CHECK" engine warning light. → OK → Fuse blows again → Repair or replace.

NO → OK → Check wiring between ECU terminal W and body ground. → OK → Try another ECU → OK → Check GAUGE fuse (10A) and "CHECK" engine warning light. → OK → Fuse blows again → Repair or replace.

No.	Terminals	Trouble	Condition	STD Voltage
11	A/C-E1(E11)	No voltage	Air conditioning ON	10 - 14 V

① There is no voltage between ECU terminals A/C and E1 (E11). (Air conditioning ON)

② Check that there is voltage between ECU terminal A/C and body ground.

NO → OK → Check wiring between ECU terminal A/C and body ground. → OK → Try another ECU → OK → Check compressor running. → OK → Check wiring between ECU terminal A/C and amplifier. → BAD → Repair or replace.

NO → OK → Check wiring between ECU terminal A/C and body ground. → OK → Try another ECU → OK → Check compressor running. → OK → Check wiring between ECU terminal A/C and amplifier. → BAD → Repair or replace.

③ Check wiring between amplifier terminal and body ground.

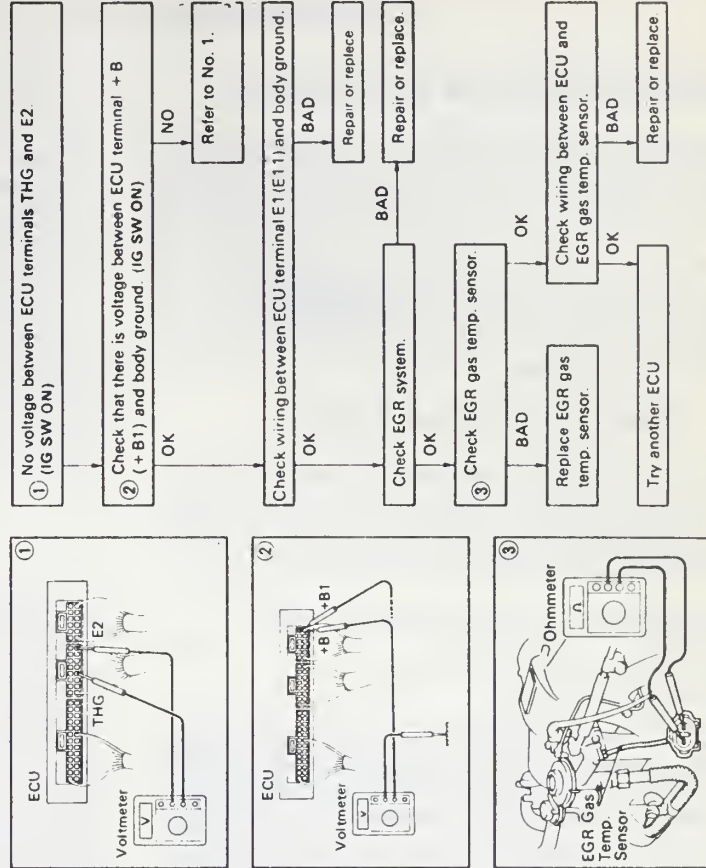
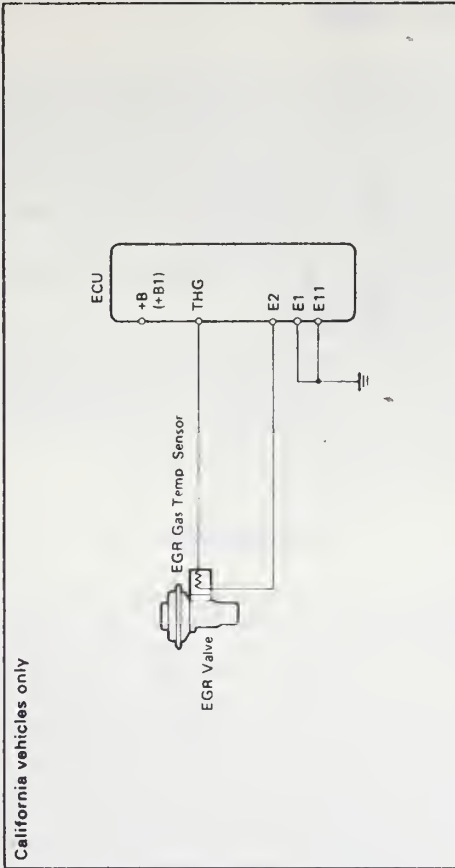
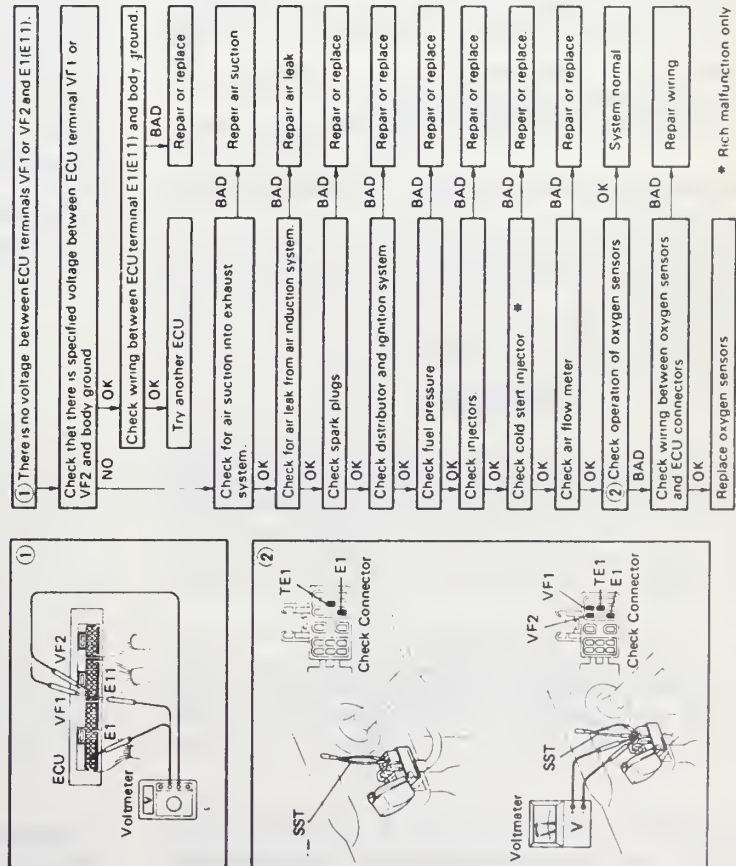
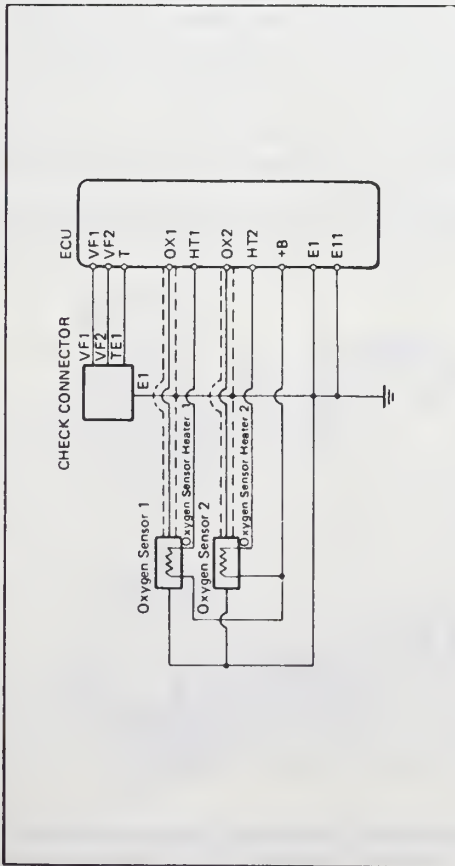
NO → OK → Check wiring between amplifier and ECU or compressor. → BAD → Repair or replace.

NO → OK → Check wiring between amplifier and ECU or compressor. → BAD → Repair or replace.

④ Check wiring between amplifier and ECU or compressor.

NO → OK → Check wiring between amplifier and ECU or compressor. → BAD → Repair or replace.

NO → OK → Check wiring between amplifier and ECU or compressor. → BAD → Repair or replace.



5 FUEL SYSTEM

CARBURETED FUEL SYSTEM

Understanding the Fuel System

An automotive fuel system consists of everything between the fuel tank and the carburetor or fuel injection unit. This includes the tank itself, all the lines, one or more fuel filters, a fuel pump (mechanical or electric), and the carburetor or fuel injection unit.

With the exception of the carburetor or fuel injection unit, the fuel system is quite simple in operation. Fuel is drawn from the tank through the fuel line by the fuel pump, which forces it through the fuel filter and from there to the carburetor where it is distributed to the cylinders.

Mechanical Fuel Pump

All 22R carbureted engines equipped with a mechanically operated fuel pump of diaphragm construction (some models use two different types of pump). A separate fuel filter is incorporated into the fuel line (see Chapter 1 for its required service). The fuel pump is located on the right side of the cylinder head.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.
2. Drain the radiator coolant.

WARNING: Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

3. Disconnect the upper radiator hose and wire it out of the way.
4. Label, disconnect and plug the three fuel lines from the fuel pump.
5. Unscrew the two fuel pump retaining bolts and remove the fuel pump and gasket.
6. Install the pump into the block and tighten the two mounting screws.

NOTE: Always use new gaskets when installing the fuel pump.

7. Reconnect the fuel lines correctly.
8. Reconnect the upper radiator hose and then fill the system with coolant.
9. Connect the negative battery cable.
10. Start the engine and check for any leaks.

TESTING

Fuel pumps should always be tested on the vehicle. The larger line between the pump and tank is the suction side of the system and the smaller line, between the pump and carburetor is the pressure side. A leak in the pressure side would be apparent because of dripping fuel. A leak in the suction side is usually only apparent because of a reduced volume of fuel delivered to the pressure side.

CAUTION

Gasoline, both liquid and vapor, is extremely explosive. Extinguish all open flame in the area including smoking materials, heaters, welders etc. Contain all spillage and keep away from sources of high temperature. Have a dry powder (Type B-C) fire extinguisher within arm's reach and know how to use it.

1. Tighten any loose line connections and look for any kinks or restrictions.
2. Disconnect the fuel line at the carburetor or fuel pump.

Disconnect the distributor-to-coil primary wire. Place a container at the end of the fuel line and crank the engine a few revolutions. If little or no fuel flows from the line, either the fuel pump is inoperative or the line is plugged. Blow through the lines with compressed air and try the test again. Reconnect the line.

3. If fuel flows in good volume, check the fuel pump pressure to be sure.
4. Attach a pressure gauge to the pressure side of the fuel line. On trucks equipped with a vapor return system, squeeze off the return hose.
5. Run the engine at idle and note the reading on the gauge. Stop the engine and compare the reading with the specifications listed in the "Tune-Up Specifications" chart. If the pump is operating properly, the pressure will be as specified and will be constant at idle speed. If pressure varies sporadically or is too high or low, the pump should be replaced.
6. Remove the pressure gauge.

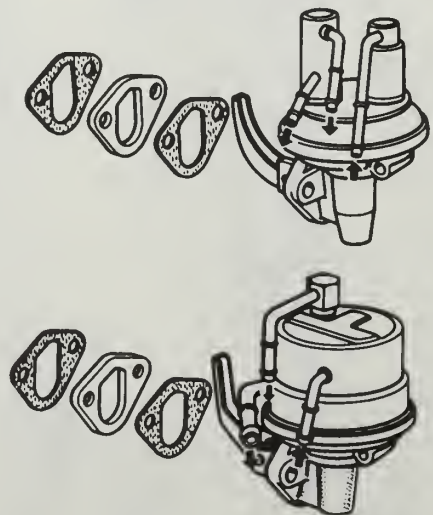
Carburetor

The carburetor is the most complex part of the fuel system. Carburetors vary greatly in construction, but they all operate basically the same way; their job is to supply the correct mixture of fuel and air to the engine in response to varying conditions.

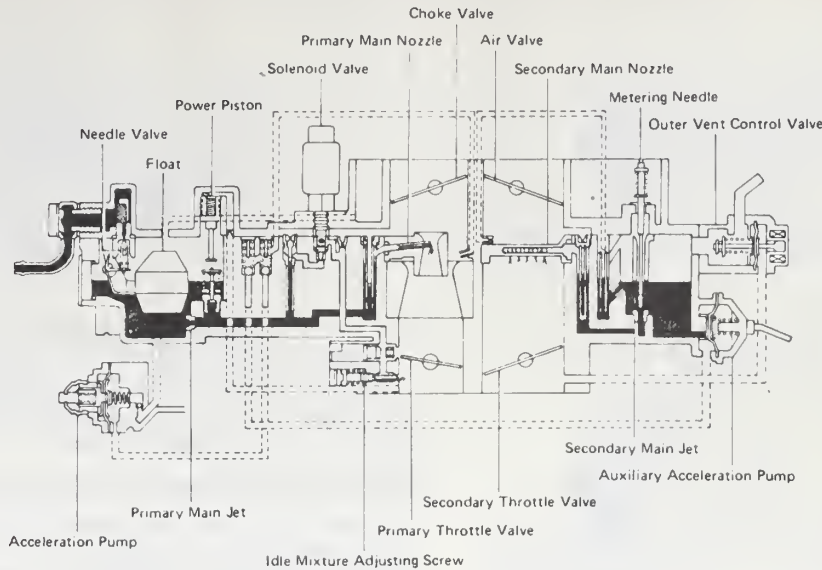
Despite their complexity in operation, carburetors function because of a simple physical principle—the venturi principle. Air is drawn into the engine by the pumping action of the pistons. As the air enters the top of the carburetor, it passes through a venturi, which is nothing more than a restriction in the throttle bore. The air speeds up as it passes through the venturi, causing a slight drop in pressure. This pressure drop pulls fuel from the float bowl through a nozzle into the throttle bore, where it mixes with the air and forms a fine mist, which is distributed to the cylinders through the intake manifold.

There are six different systems (air/fuel circuits) in a carburetor that make it work; the Float system, Main Metering system, Idle and Low-Speed system, Accelerator Pump system, Power system, and the Choke system. The way these systems are arranged in the carburetor determines the carburetor's size and shape.

Carburetors all function in the same fashion; larger engines have larger carburetors to move more air and fuel, but the prin-



Two types of fuel pump may be found on 22R engines. Note the difference in the diaphragm arm



Cross section of 22R carburetor

ciple is still the same. Older units don't have as many external linkages and controls to manage emissions and driveability, but the principle is still the same.

It's important to remember that carburetors seldom give trouble during normal operation. Other than changing the fuel and air filters and making sure the idle speed is OK at every tune-up, there's not much maintenance you can perform on the average carburetor. Quality of fuel and presence of water in the system will affect the carburetor; dirt particles in the fuel can clog the jets and water causes rust and corrosion. If the vehicle is to be parked or laid up for a long period of time, drain the carburetor to prevent the evaporating fuel from gumming up the system.

The carburetors used on Toyota trucks are conventional 2 bbl, downdraft types similar to domestic carburetors. The main circuits are: primary, for normal operational requirements; secondary, to supply high speed/high load fuel needs; float, to supply fuel to the primary and secondary circuits; accelerator, to supply fuel for quick and safe acceleration; choke, for reliable starting in cold weather; and power valve, for fuel economy.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.
2. Loosen the radiator drain plug and drain the coolant into a suitable container.

WARNING: Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

3. Unscrew the mounting screws and remove the air filter housing. Disconnect all hoses and lines leading from the air cleaner.
4. Tag and disconnect all fuel, vacuum, coolant and electrical lines or hoses leading from the carburetor.
5. Disconnect the accelerator linkage from the carburetor. On cars equipped with an automatic transmission, disconnect the throttle cable linkage running from the transmission.
6. Remove the four carburetor mounting bolts and lift off the carburetor and its gasket.

NOTE: Cover the manifold opening with a clean rag to prevent objects from falling into the engine.

To install:

7. Install the carburetor, tighten the mounting bolts and reconnect all linkages.
8. Connect the vacuum and fuel lines; connect the wiring harness.
9. Install the air cleaner assembly, making sure it is correctly seated on the carburetor.
10. Refill the coolant. Connect the negative battery cable.
11. Start the engine and check for any leaks. Check the float level.

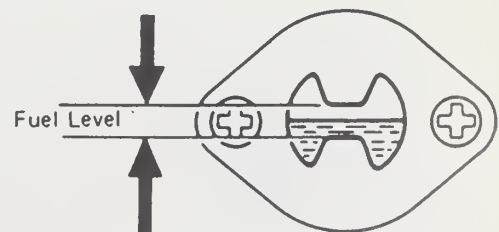
ADJUSTMENTS

Float Level Adjustment

Float level adjustments are unnecessary if the fuel level falls within the lines on the sight glass when the engine is running. The sight glass is located on the side of the carburetor and is literally a window on the float bowl. Removing the air cleaner is usually required for access, although it can be done with an extension or dental mirror.

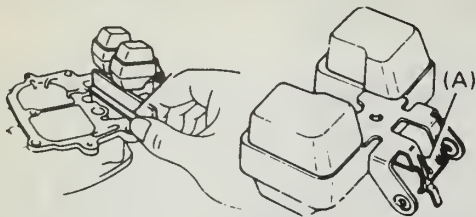
With the carburetor off the engine, there are two float level adjustments which may be made. One is done with the air horn inverted, so that the float is in a fully raised position; the other is with the air horn in an upright position, so that the float falls to the bottom of its travel.

The float level is measured either with a special carburetor float level gauge, which comes with a rebuilding kit, or with a standard wire gauge.

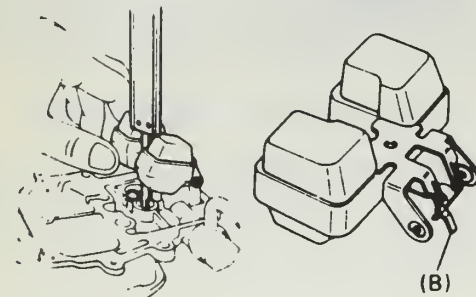


If the fuel level is approximately centered in the window, the float adjustment is proper

5 FUEL SYSTEM



With the air horn inverted, bend tab A to adjust the upper float limit



Bend tab B to adjust the lower float limit when the air horn is upright

1. Turn the air horn upside down and let the float hang down by its own weight.
2. Using a special float gauge (available at your local dealer), check the clearance between the tip of the float and the flat surface of the air horn. The clearance should be 9.8mm (0.386 in.).

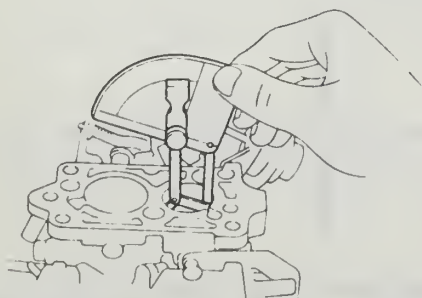
NOTE: This measurement should be made without the gasket on the air horn.

3. If the float clearance is not within specifications, adjust it by bending the upper (A) float tab.
4. Lift up the float and check the clearance between the air horn and the float bottom. A Vernier caliper works well for this measurement. The clearance should be 48mm (1.89 inches)
5. If the clearance is not within specifications, adjust it by bending the lower float tab (B).

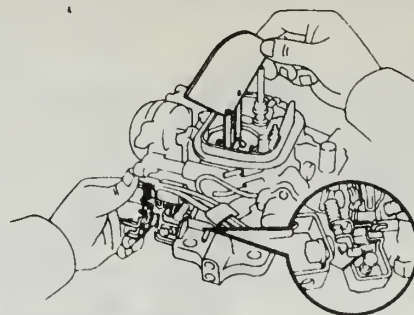
Fast Idle Adjustment—Carburetor Off Truck

NOTE: A special blade angle tool must be obtained to properly make this adjustment.

1. Remove the carburetor.
2. Set the throttle shaft lever to the first step of the fast idle cam. Make certain the choke plate (blade) is completely closed.
3. Attach the blade angle tool to the primary throttle blade. Adjust the primary throttle blade angle to 23° (Calif.) or 24.5° (Federal) from horizontal by turning the fast idle screw.



Measuring the primary throttle plate angle



Adjusting the choke unloader

4. Remove the angle tool from the carburetor and install the carburetor as previously outlined.

Fast Idle Adjustment—Carburetor On Truck

1. Start the engine and allow it to reach normal operating temperature.
2. Stop the engine and connect a tachometer to the engine.
3. Remove the air cleaner assembly.
4. Disconnect and plug the vacuum hoses for the HAI and MC systems if so equipped. Disconnect and plug the vacuum hose from the choke opener diaphragm and EGR valve; plug the ends.
6. Make certain that all accessories are switched OFF.
7. Open the throttle valve slightly, push the choke plate fully closed and release the throttle. This sets the carburetor in the high idle position.
8. Without touching the accelerator pedal, start the engine and read the tachometer. If necessary, adjust the fast idle speed to by turning the fast idle screw. Correct fast idle speed: Federal, 3000 rpm; California, 2600 rpm.
9. Stop the engine. Reconnect the vacuum hoses, disconnect the tachometer and reinstall the air cleaner.

Unloader Adjustment

The unloader adjustment is made with the primary throttle valve fully open. With the valve open, check the choke valve angle with a special gauge supplied in the rebuilding kit or with a gauge of the proper angle fabricated out of cardboard. The angle of the choke valve opening should be 45°.

To adjust the angle, bend the fast idle lever until the proper measurement is achieved.

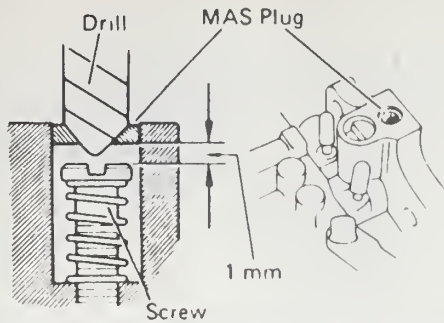
Choke Breaker Adjustment

1. With the engine OFF and the air cleaner removed, apply vacuum to the choke breaker diaphragm.
2. Close the choke by hand, and remove your hand. Check that the angle of the choke plate is 42° from horizontal.
3. If the angle is incorrect, adjust it by bending the choke breaker link.

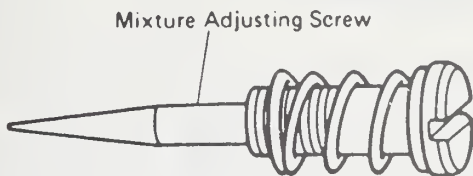
Idle Mixture Adjusting Screw

As stated in Section 2, the mixture adjusting screw (MAS) should be the very last item you try to adjust during tune up or troubleshooting. The MAS is concealed behind a plug; the plug cannot be removed with the carburetor on the car. If adjustment is to be done, great care must be taken during removal of the plug; clearances are very tight and damage to the carburetor can occur.

1. Remove the carburetor.
2. Plug each carburetor vacuum port to prevent entry of metal particles.
3. Mark the center of the plug with a punch. Use a 0.256 in. drill bit (6.5mm) to drill a hole in the center of the plug.



Slowly and Carefully are the guidelines for drilling out the mixture adjusting plug. The screw below the plug must not be damaged



Inspect the mixture adjusting screw before reinstalling

WARNING: The head of the screw is only 0.04 inch (1mm) below the plug—drill carefully and slowly to avoid damage.

4. The plug may come out with the drill at this time. If not, use a small screwdriver to reach through the hole and gently turn the adjusting screw all the way in. Do NOT overtighten the screw; just tighten it until it touches bottom.

5. Use a 0.295 in. (7.5mm) drill to enlarge the hole in the plug and remove it.

6. Remove the adjusting screw. Inspect the tip for any damage; remove any steel particles. If the drill has damaged the top of the screw, it must be replaced.

7. Reinstall the adjusting screw. Turn it all the way in, just touching bottom.

8. Once the screw has bottomed, turn it out 3½ turns.

9. Reinstall the carburetor and air cleaner.

10. Before adjusting idle speed and mixture, ALL the following conditions must be met:

- Air cleaner properly installed.
- Engine running at normal operating temperature.
- Choke fully opened.
- All accessories OFF.
- All vacuum lines connected.
- Ignition timing correctly set.
- Transmission in neutral or N.
- Fuel level should be approximately centered in float glass.
- For Calif. vehicles, EBCV off.

11. Connect a tachometer. Start the engine.

12. Turn the MAS until the highest possible rpm is achieved.

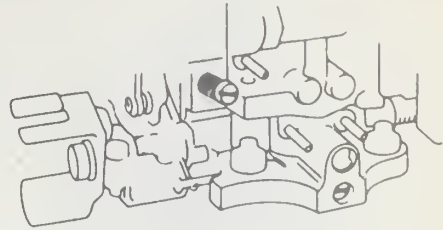
13. Turn the idle speed adjusting screw until 740 rpm is achieved. The idle speed adjusting screw is located above and to the left ("10 o'clock") of the mixture adjusting screw.

14. Repeat Steps 12 and 13 several times. When the idle does not rise no matter how much the MAS is turned, proceed to the next Step.

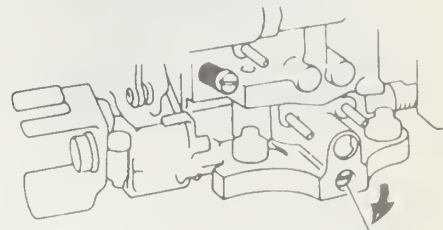
15. Turn the MAS screw IN to set the idle to 700 rpm.

16. Turn the engine OFF. Remove the air cleaner.

Idle Speed Adjusting Screw



Idle Mixture Adjusting Screw



Don't get these two screws confused during Idle speed setting

17. Gently tap a new plug into place over the MAS plug. Check and adjust the fast idle speed as described in this Section.

NOTE: The method used to set the idle mixture and speed is also known as the Lean Drop Method

Automatic Choke Inspection

The automatic choke system sets and opens completely automatically, with no input from the accelerator pedal. The driver no longer sets the choke; it is set by the expansion or contraction of the bimetal coil. Refer to Section 4, Emission Controls, for complete inspection procedures.

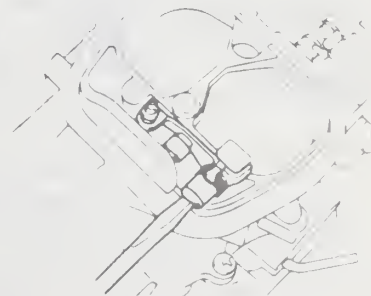
CARBURETOR OVERHAUL

Efficient carburetion depends on careful cleaning and inspection during overhaul, since dirt, gum, water, or varnish in or on the carburetor parts are often responsible for poor performance.

Overhaul your carburetor in a clean, dust-free area. Carefully disassemble the carburetor, referring often to the exploded views. Keep all similar and look-alike parts segregated during disassembly and cleaning to avoid accidental interchange during assembly.

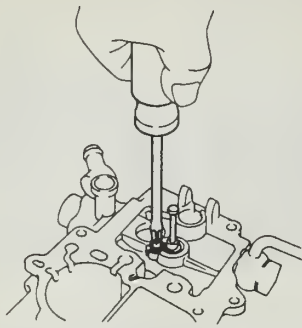
Carburetor overhaul kits are recommended for each overhaul. These kits contain all gaskets and new parts to replace those that deteriorate most rapidly. Failure to replace all parts supplied with the kit (especially gaskets) can result in poor performance and a leaks.

NOTE: The following procedure is organized so that only one group of components is worked on at a time.

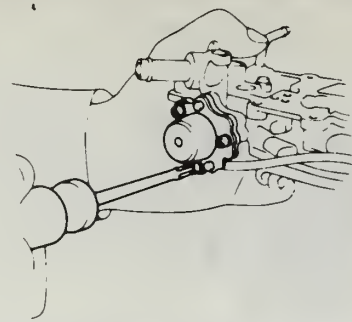


Removing the metering needle

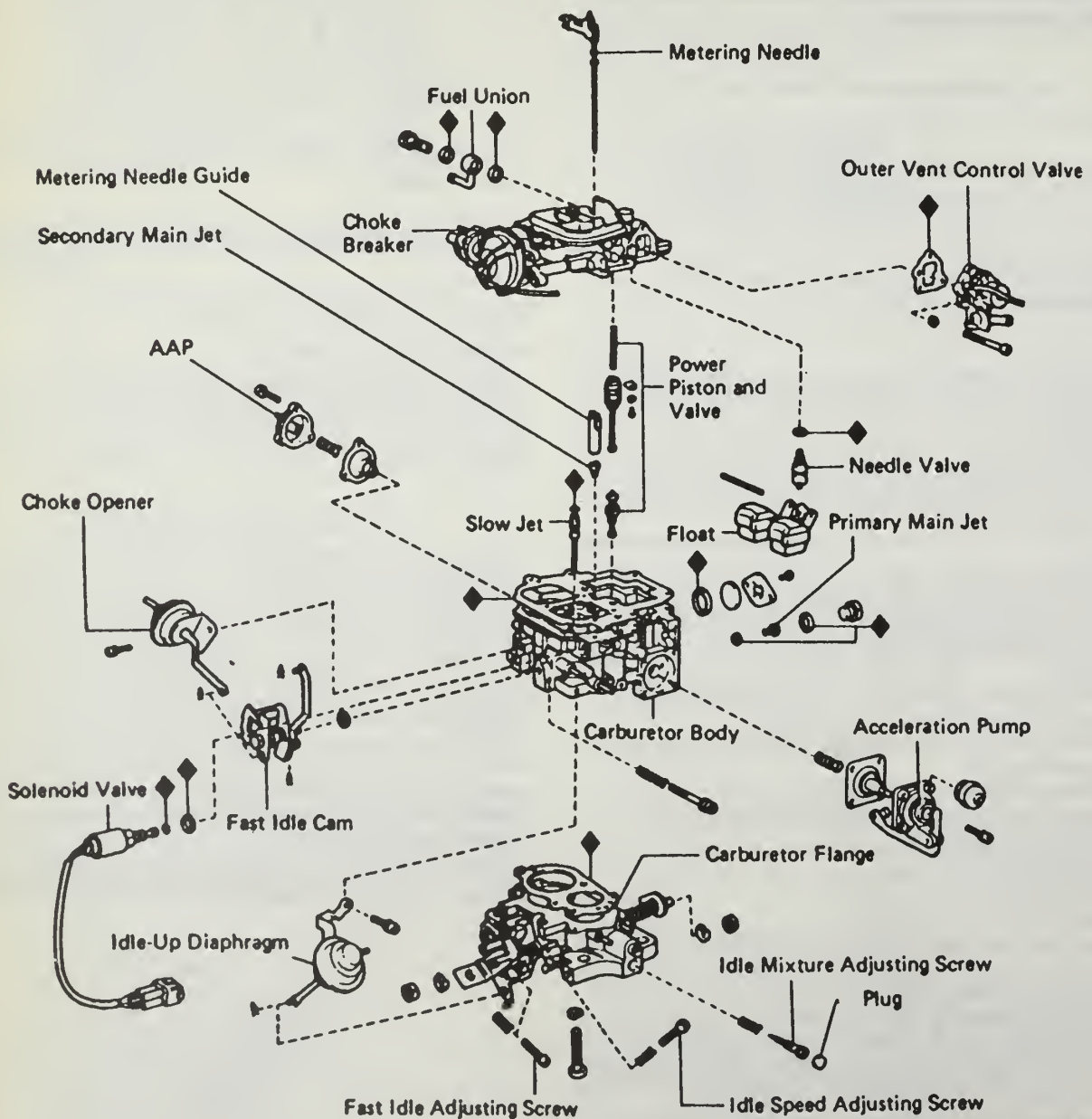
5 FUEL SYSTEM



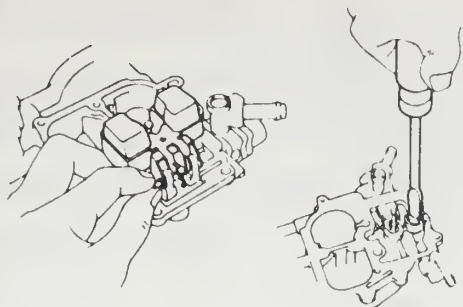
Removing the power piston



The outer vent control valve is removed with 3 screws



22R carburetor components



Don't damage the float and needle during removal

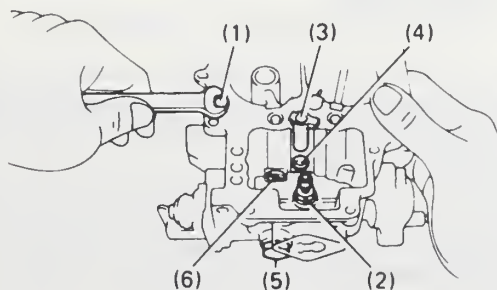
This will help eliminate confusion of parts or sub-assemblies on the bench. Always keep parts in order; take great care not to lose small parts or clips.

AIR HORN

1. Remove the carburetor.
2. Loosen the screw and remove the metering needle.
3. Disconnect the fast idle linkage and air valve connecting rod.
4. Remove the 5 air horn screws and lift the air horn from the body. Remove the gasket and discard it.
5. Remove the pivot pin and the float with the needle valve.
6. Loosen the retainer screw for the power piston. Hold the piston, rotate the retainer and remove the piston and spring.
7. Remove the 3 screws holding the outer vent control valve and remove the valve.

Carburetor Body

8. Using a set of carburetor wrenches or special tool 09922-00010, remove the slow jet. Remove the power valve. Remove the metering needle guide and secondary main jet. Remove the plug and the primary main jet. Use the illustration to help you.

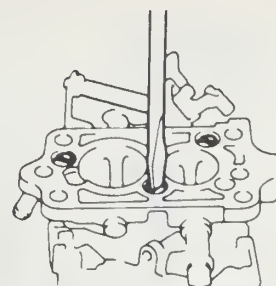


Remove the slow jet (1), the power valve (2), the metering needle guide (3), main jet (4), plug (5) and the primary jet (6)

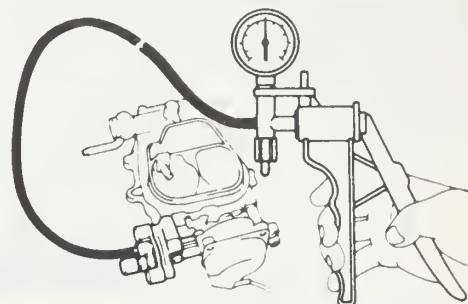
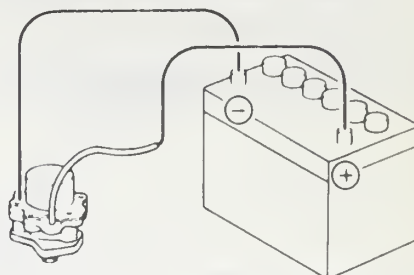
9. Remove the fuel cut solenoid from the carburetor body.
10. At the accelerator pump, remove the 4 screws. Remove the pump housing, diaphragm and spring.
11. Remove the auxiliary acceleration pump.
12. Disconnect the linkage and remove the idle-up diaphragm.
13. Disconnect the choke opener link; remove the choke opener.
14. Remove the three screws and separate the body from the flange (lowest portion).

Cleaning and Testing

15. Clean all the cast metal parts with a soft brush and carburetor solvent. Clean any carbon from around the throttle plates. Blow out all jets and passages with compressed air.
16. Inspect the power piston. Make sure it moves smoothly.
17. Test the fuel cut solenoid. Connect the wire leads to the battery terminals; you should feel a distinct click inside the sole-



Separate the body and flange



Test components for both electrical and vacuums function

noid as power is connected and disconnected at the battery. If this click is not felt, replace the solenoid. Replace the O-ring.

18. Inspect the outer vent control valve for damaged valve or valve seats. Check the valve for smoothness of motion. Connect the wire leads to the battery terminals; you should feel a distinct click inside the valve as power is connected and disconnected at the battery. If this click is not felt, replace the solenoid.

19. Inspect the choke breaker diaphragm by applying vacuum to the diaphragm. The vacuum should not drop immediately and the choke should open slightly as vacuum is applied.

20. Use an ohmmeter to check choke heater resistance. Resistance should be 20-22 ohms at 68°F. Resistance will vary with temperature; use good judgment when interpreting test results.

21. Inspect the choke opener and idle-up diaphragms. Apply vacuum to the diaphragm; vacuum should not drop immediately and the linkages should move when vacuum is applied.

Assembly

22. Place a new gasket in position on the flange; install the body and tighten the 3 screws.

23. Install the auxiliary accelerator pump. First, install the diaphragm with outer gasket, then the spring, cover and screws.

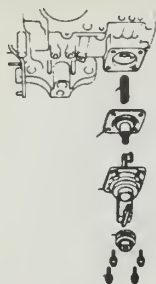
24. Install the acceleration pump beginning with the spring, then the diaphragm, cover, boot and screws.

25. Install the choke opener and connect the linkage.

26. Install the idle up diaphragm and connect the linkage.

27. Install the fuel cut solenoid. Always use a new gasket and new O-ring

5 FUEL SYSTEM



Install the accelerator pump in the correct order

28. Install the primary main jet over a new gasket. Install the plug over a new gasket. Install the secondary main jet and metering needle guide.
29. Install the power valve. Place a new O-ring on the slow jet and install the slow jet.
30. On the air horn, install the outer vent control valve with a new gasket.

31. Place the power piston spring and piston into the bore. While pushing the piston, rotate the retainer over the piston and tighten the retaining screw.

32. In the fuel inlet, install a new gasket and the valve seat. Install the needle valve onto the seat. Insert the lip of the float under the wire of the needle valve. Install the float and secure the pin.

33. Adjust the float level, using the procedure listed separately in this Section.

34. Put a new gasket on the body and install the air horn. When installing the screws, make certain to install the external components held by the screws such as the inlet bracket, number plate and wire clamps.

35. Connect the fast idle link and air valve connecting rods.

36. Install the metering needle with a collar. Hook the spring end into the hole. Insert the washer and tighten the screw.

37. Adjust the carburetor on the bench, using the various procedures listed in this section.

38. Install the carburetor.

39. Start the engine; make final adjustments as necessary.

TORQUE SPECIFICATIONS

Component	English	Metric
Fuel pump bracket-to-tank:	30 inch lbs.	4 Nm
Throttle body mounting bolts:	9-13 ft. lbs.	12-18 Nm
Injector mounting bolts:	11-15 ft. lbs.	15-20 Nm
Fuel tank bolts:	11-16 ft. lbs.	15-22 Nm

FUEL INJECTION SYSTEM

Engine troubles are not usually caused by the EFI system. When troubleshooting a problem, first check the condition of all other related systems.

Many times the most frequent cause of problems is a bad contact in a wiring connector; always make sure that the connections are secure. When inspecting the connector, pay particular attention to the following

1. Check to see that the terminals are not bent.
2. Check to see that the connector is pushed in all the way and locked.
3. Check that there is no change in signal when the connector is tapped or wiggled.

NOTE: The worst enemy of any fuel injection system is water or moisture. The best (i.e., cheapest and simplest) insurance for your truck's injection system is to change the fuel filter as frequently as the maintenance schedule recommends. When you follow the filter change interval strictly, many possible expensive injection system problems are eliminated.

Electric Fuel Pump

All Toyota fuel-injected vehicles are equipped with an electric fuel pump. The pump is located inside the fuel tank. For a fuel injection system to work properly, the pump must develop pressures well above those of a mechanical fuel pump. This high pressure is maintained within the lines even when the engine is off. Extreme caution must be used to safely release the pressurized fuel before any work is begun.

CAUTION

Always relieve the fuel pressure within the system before any work is begun on any fuel component. Failure to safely relieve the pressure may result in fire and/or serious injury.

To relieve the fuel pressure, wrap a clean towel or rag around either the cold start injector fitting or the union bolt (banjo bolt) at the fuel delivery rail. Slowly loosen the bolt holding the fuel line and allow pressurized fuel to escape into the rag. Do NOT allow the fuel to spray from the fitting; always wrap it in a rag. Pressure may also be relieved at the fuel filter if desired.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable. Safely relieve the fuel pressure within the system. Drain the fuel from the tank and then remove the fuel tank.

2. Remove the seven bolts and then pull the fuel pump bracket up and out of the fuel tank.

3. Remove the two nuts and then disconnect the wires at the fuel pump.

4. Pull the fuel pump out of the lower side of the bracket. Disconnect the pump from the fuel hose.

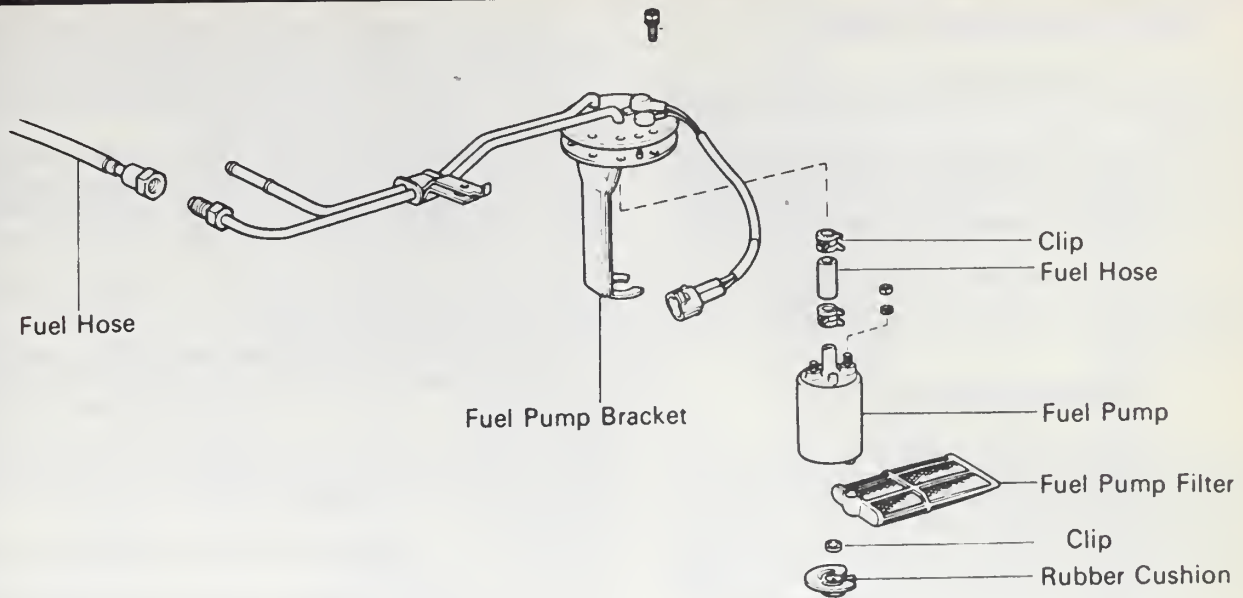
5. Remove the rubber cushion and the clip. Disconnect the fuel pump filter from the pump.

To install:

6. Install the fuel pump filter to the pump.

7. Insert the outlet port of the fuel pump into the fuel hose.

8. Install the rubber cushion to the lower side of the fuel pump.

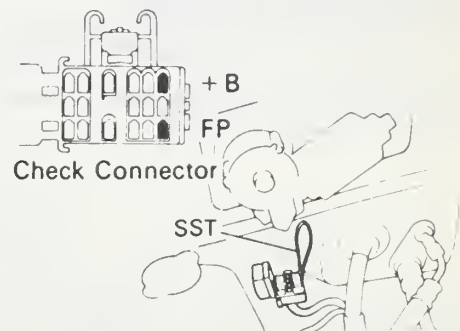


Land Cruiser electric fuel pump. All others are similar

9. Push the lower side of the fuel pump (and the rubber cushion) into the pump bracket.
10. Using a new gasket, position the bracket on the fuel tank and then install and tighten the seven mounting bolts to 30 inch lbs. (3.4 Nm).
11. Install the fuel tank.
12. Start the truck and check for any loose connections or leaks.

TESTING (PUMP INSTALLED)

1. Turn the ignition switch to the "ON" position, but don't start the engine.
2. At the check connector, jumper terminals B+ and FP. This should cause the fuel pump to run; check that there is pressure in the fuel return line from the pressure regulator. You should also hear fuel return noises.
3. Turn the ignition switch OFF and remove the jumper wire. If the fuel pump did not function or if there was no pressure in the line, check the fuses, links, EFI main relay, ECU and wiring connections.



Connecting these two terminals at the check connector will cause the fuel pump to run if the ignition is ON

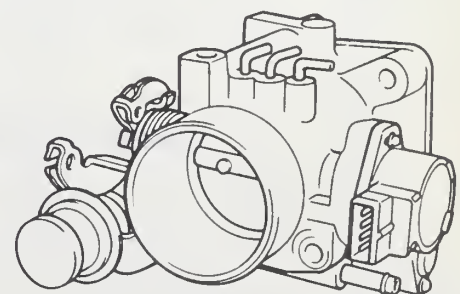
Throttle Body

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.
2. Drain the engine coolant.

WARNING: Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

3. Tag and disconnect all lines, hoses or wires that lead from the throttle body. On 3VZ-E with automatic transmission, disconnect the throttle control cable.
4. Remove the air intake connector and the air cleaner hose.
5. Unscrew the mounting bolts and remove the throttle body and gasket. The cast metal parts may be cleaned with a soft brush and carburetor solvent. If possible, use low pressure compressed air to blow out the passages and tubing.



The throttle body controls the amount of air entering the engine. The throttle position sensor on the side of the unit communicates the position of the throttle to the ECU

To install:

6. Install the throttle body using a new gasket and tighten the mounting bolts to 9-13 ft. lbs. (12-18 Nm).
7. Connect the air cleaner hose and the air intake connector.
8. Reconnect all lines, hoses and wires.
9. Fill the engine with coolant and connect the battery cable.

5 FUEL SYSTEM

TESTING AND ADJUSTMENT

1. Check that the throttle linkage moves smoothly.
2. Start the engine and remove the hose(s) one at a time from the vacuum port.
3. With your finger, check that there is no vacuum at idle and that there IS vacuum at anything other than idle. For 22R-E and 3VZ-E, check that vacuum is present at or above 3500 rpm.
4. Unplug the electrical connector from the throttle position sensor.
5. Insert a flat feeler gauge between the throttle stop screw and the stop lever.
6. Using an ohmmeter, check the continuity between each terminal on the sensor.

Fuel Injectors

There is one fuel injector for each cylinder and a cold start injector which provides additional fuel during start-up. They spray fuel into the intake port, in front of the intake valve. When the injector is energized, the coil pulls the plunger up, opening the needle valve and allowing the fuel to pass through the injector. Opening of the injectors is controlled by the EFI computer. The injectors operate at low pressure and are open for only a fraction of a second at a time.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.
2. Safely discharge the fuel pressure in the system. Place a suitable container under the intake manifold to catch any dripping fuel.
3. On 3VZ-E and 22R-E, drain the coolant. On 3F-E, disconnect the accelerator and throttle cable.

4. Remove the air intake chamber. Removal of the throttle body is required on 22R-E. On 3F-E, make particularly certain all vacuum hoses and wires are labeled; they are numerous.

5. On all engines, tag and disconnect all hoses and wires which interfere with injector removal.

6. On 3VZ-E and 3F-E engines, the main engine wiring harness must be moved out of the way. This will require unplugging various connectors at components on the engine until the harness can be repositioned. Label everything before disconnecting it.

7. Unplug the wiring connectors from the tops of the fuel injectors and remove the two plastic clamps that hold the wiring harness to the fuel delivery pipe.

8. For 22R-E and 3F-E, disconnect the fuel line to the fuel delivery rail. Carefully remove the fuel rail (with the injectors attached) from the engine. Do not allow the injectors to fall out during removal.

9. For 3VZ-E, disconnect the vacuum hose from the BVSF. Remove the four union bolts and Nos. 2 and 3 fuel pipes. Pull the injectors from the delivery pipes.

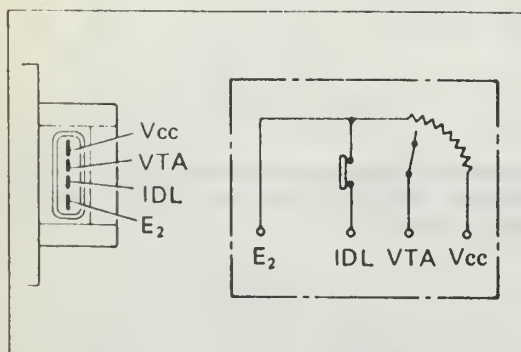
To install:

10. Insert new insulators into the injector holes on the intake manifold.

11. Install the grommet and a new O-ring to the delivery pipe end of each injector.

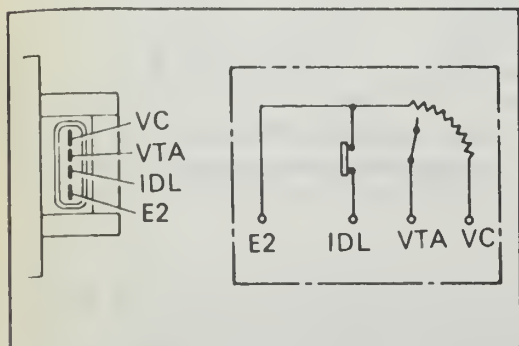
12. Apply a thin coat of gasoline to the O-ring on each injector and then press them into the delivery pipe. Make absolutely certain the injector is squarely and firmly mounted in the pipe; it must not be crooked.

13. Install the injectors together with the delivery pipe in the intake manifold. Tighten the mounting bolts to 11-15 ft. lbs. Once installed, make sure the injectors turn freely in their mounts. If one doesn't turn, remove the injector and check the O-ring.



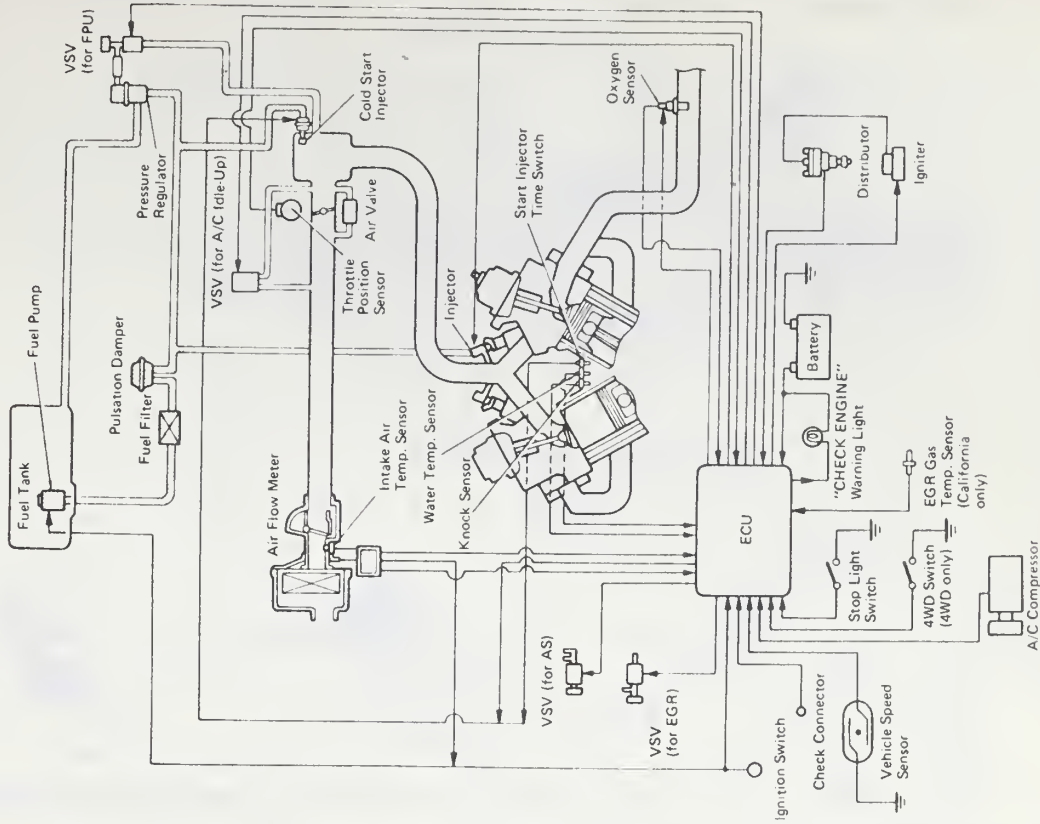
Clearance between lever and stop screw	Between terminals	Resistance
0 mm (0 in.)	VTA - E ₂	0.2 - 0.8 kΩ
0.50 mm (0.0197 in.)	IDL - E ₂	Less than 2.3 kΩ
0.77 mm (0.0303 in.)	IDL - E ₂	Infinity
Throttle valve fully opened position	VTA - E ₂	3.3 - 10 kΩ
—	Vcc - E ₂	4 - 9 kΩ

Throttle body testing specifications, 22R-E and 3VZ-E

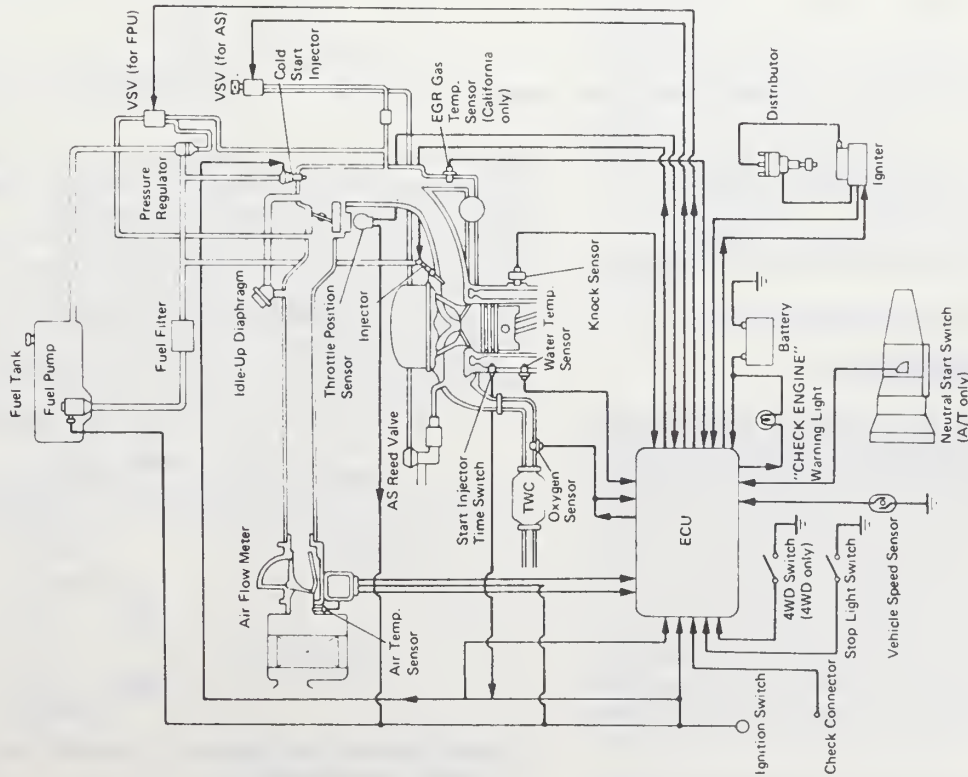


Clearance between lever and stop screw	Between terminals	Resistance
0 mm (0 in.)	VTA - E ₂	0.3 - 6.3 kΩ
0.77 mm (0.0303 in.)	IDL - E ₂	Less than 2.3 kΩ
1.09 mm (0.0429 in.)	IDL - E ₂	Infinity
Throttle valve fully opened position	VTA - E ₂	3.5 - 10.3 kΩ
—	VC - E ₂	4.25 - 8.25 kΩ

Throttle body testing specifications, 3F-E

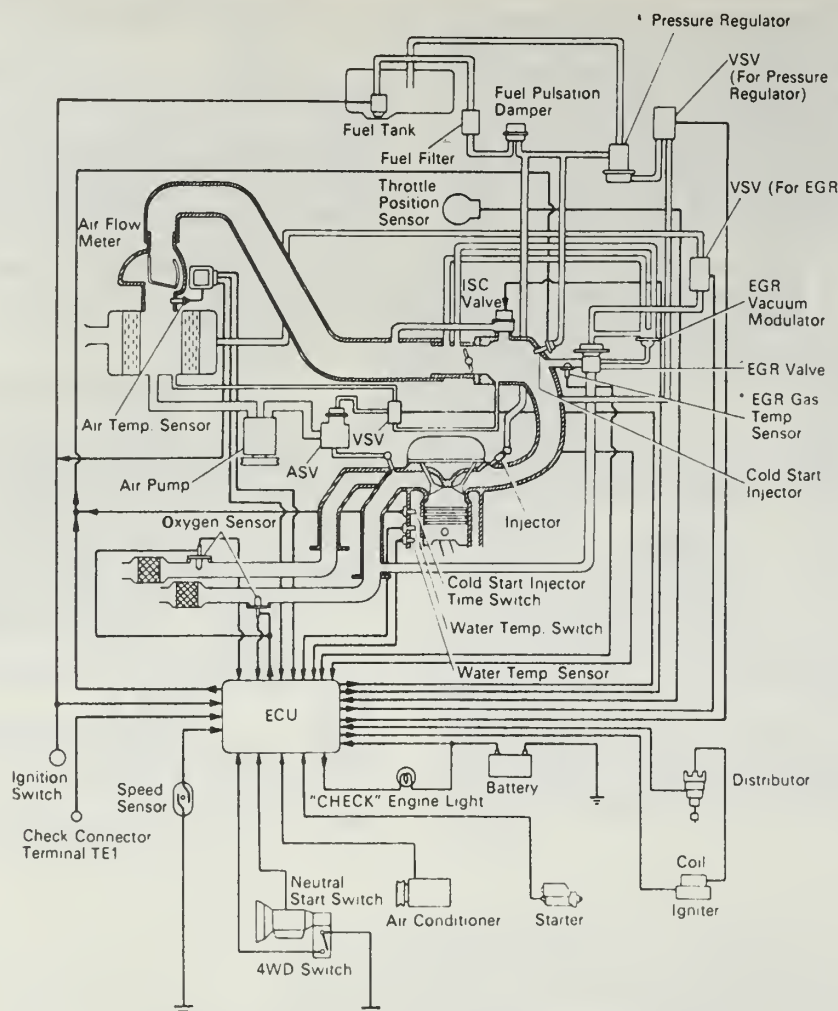


3VZ-E fuel injection system schematic



22R-E fuel injection system schematic

5 FUEL SYSTEM



3F-E fuel Injection system schematic

14. Clip the wiring harness into the delivery pipe and then connect the wiring connectors to the top of each injector.
15. Reconnect all hoses and wires.
16. Install the throttle body and air intake chamber.
17. Refill the coolant if it was drained. Connect the battery cable.
18. Start the engine and check for any fuel leaks.

TESTING

Correct testing of the fuel injectors requires specific equipment not usually available outside a dealership or a fuel lab. It is recommended that any checking or testing of the injectors, other than that included below, be left to a properly equipped service facility.

Injector operation can be checked with the injectors installed in the engine. A sound scope is needed here, a stethoscope-like device available from most auto tool and parts jobbers.

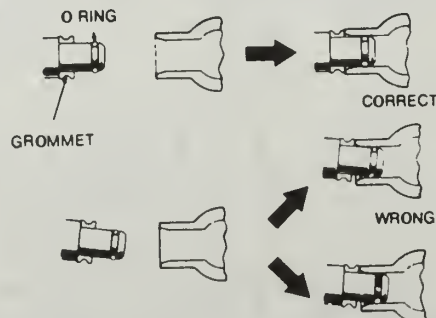
With the engine running or cranking, check each injector for normal operating noise (a buzzing or humming), which changes in proportion to engine rpm. If a sound scope is not available to you, check injector operation by touching each injector with your finger. If no sound or an unusual sound is heard, check the wiring connector, or have the injector checked professionally.

With the engine OFF, measure injector resistance by unplugging the wiring connector from the injector, and connecting an

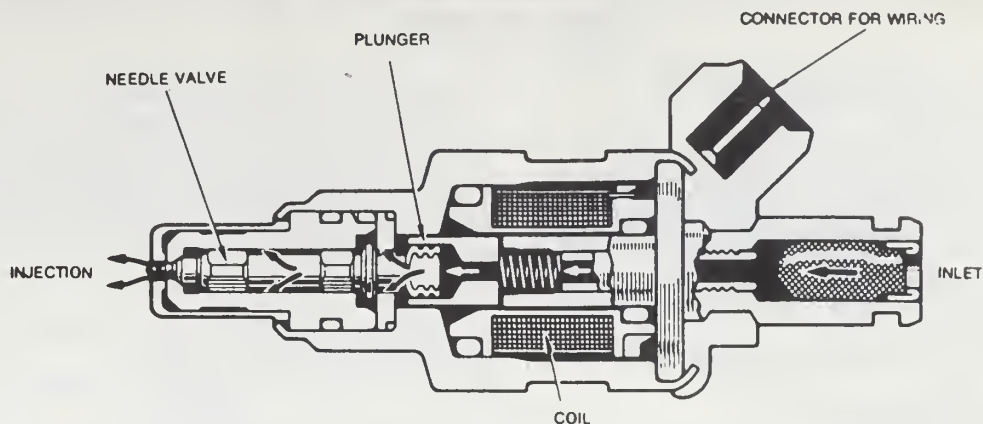
ohmmeter across the terminals of the injector. Check the continuity at both terminals; resistance should be: 13.4–14.2 ohms. Resistance will vary with injector temperature; use good judgment when interpreting results.

Cold Start Injector

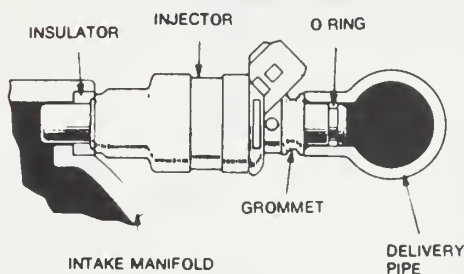
During cold engine starting, the cold start injector is used to supply additional fuel to the intake manifold to aid in initial



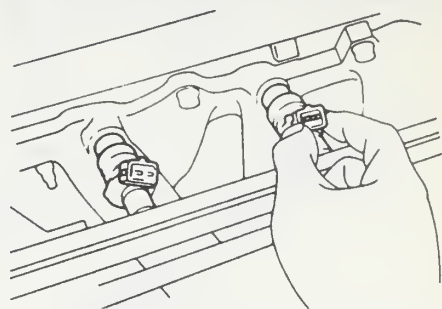
Make sure that the injector is inserted into the fuel delivery pipe properly



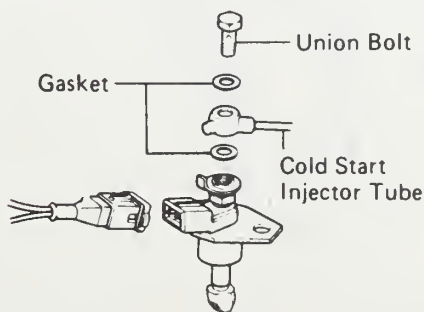
Cut-away view of fuel injector



The injector must fit squarely into the delivery pipe



Make sure the injector can rotate in its mount; if not, check the O-ring



Cold start injector

start-up. The opening and closing of the injector is determined by the Start Injector Time Switch. When the engine coolant temperature falls below a certain point, the switch opens the cold start injector. As the engine coolant warms up, the switch will close the injector.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.
2. Safely relieve the fuel pressure. Remove the cold start injector union bolt(s) on the delivery pipe. Before removing the

union bolt, place a suitable container under it to catch any escaping fuel.

3. Disconnect the wiring connector at the injector.
4. Unscrew the mounting bolts and then remove the cold start injector from the air intake chamber.
5. Install the cold start injector into the intake chamber and tighten the mounting bolts.
6. Connect the wiring connector.
7. Connect the delivery pipe to the injector and then connect the battery cable.

NOTE: Always use a new gasket when reinstalling the injector.

8. Start the engine and check for any leaks.

EFI Computer

The EFI computer is located below the glove box in the right side kick panel, except on 3F-E, where it's found behind the glove box. Replacement and/or inspection of this unit should be left to an authorized service facility; there is **NOTHING** you can do to repair it other than check that the plug is firmly seated.

FUEL TANK

REMOVAL AND INSTALLATION

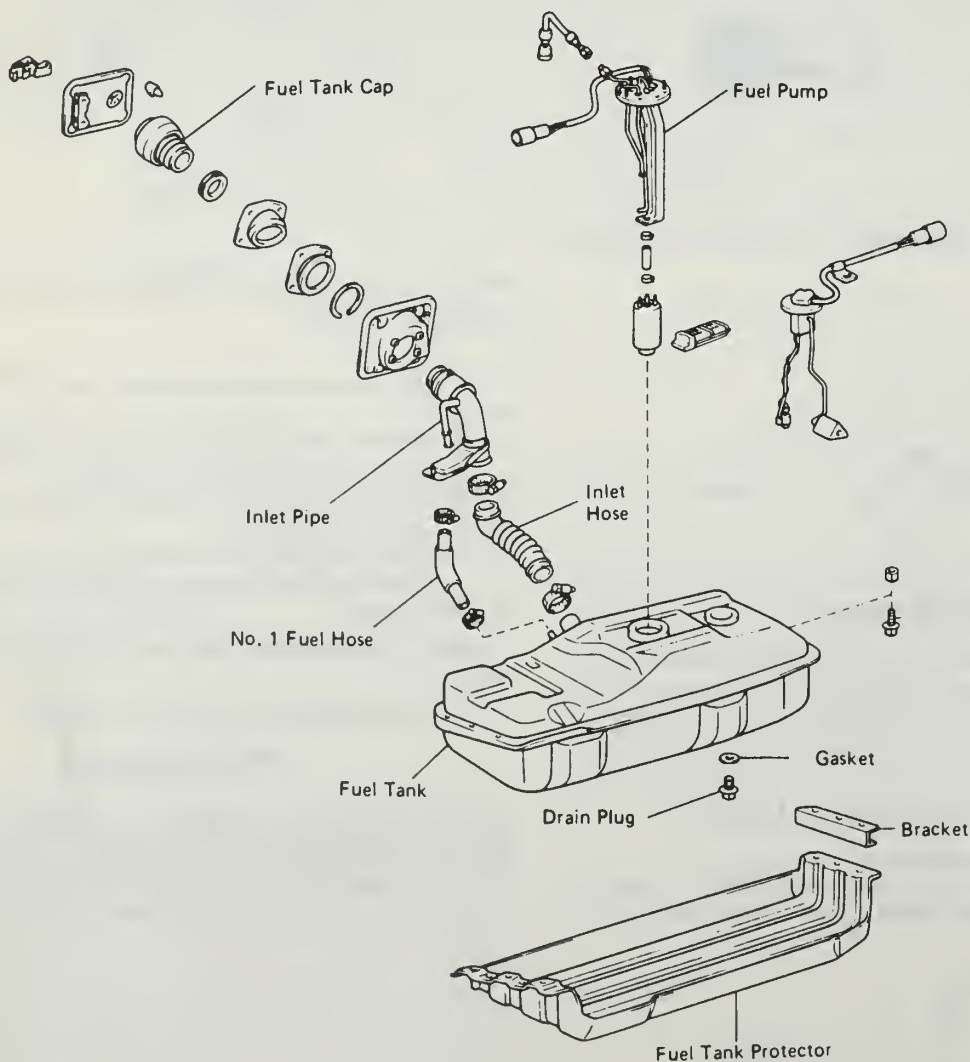
1. Remove the negative battery cable.
2. Jack up the vehicle and support it with jack stands.
3. Remove the drain plug and drain any remaining fuel into a suitable container. Remember that it is possible to have several gallons in the tank; be prepared with sufficient containers. It is best to run the tank as low on fuel as possible before removing it, but Empty on the gauge may leave 2 or 3 gallons in the tank.
4. Disconnect the plug from the pump and sending unit. Remove the gravel shield from the tank.
5. Disconnect the fuel lines. Plug all the lines to prevent fuel from leaking.
6. Disconnect the filler neck and vent line.
7. Remove the fuel tank protector.
8. Remove the bolts holding the tank to the vehicle and carefully lower the tank. It is recommended that a floor jack with a broad piece of lumber be placed to support the tank.

9. Remove the fuel pump assembly.

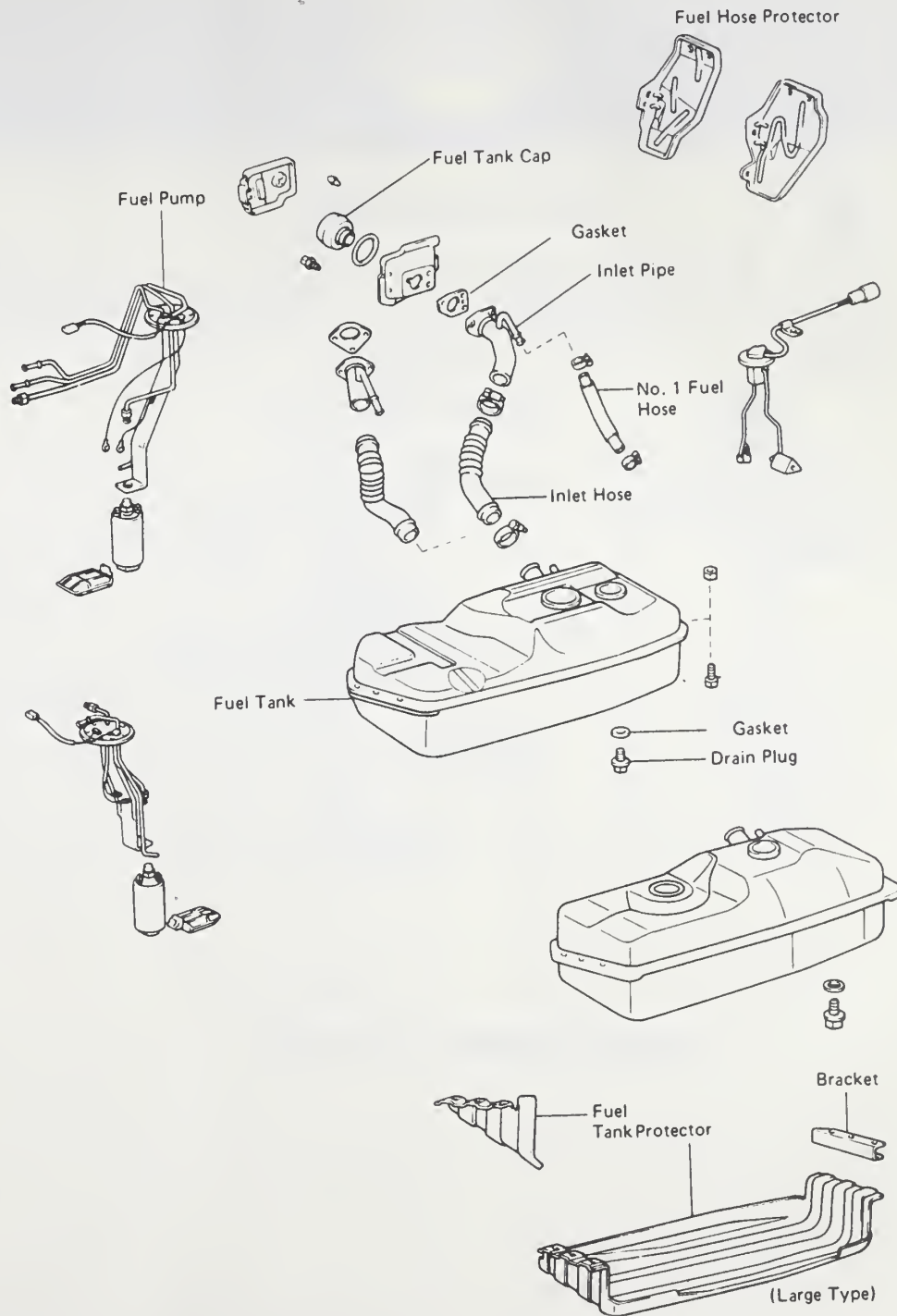
CAUTION

Even though the tank has been drained, it still contains highly explosive fuel vapor. Immediately place the tank outside; never store in the house or garage. Unless the tank is to be immediately reinstalled, use a hose to fill the tank with water as full as possible. This will flush remaining fuel and vapor from the tank and also carry off any dirt which has accumulated.

10. Make certain the fuel tank is completely dry if it has been flushed. Install the pump assembly.
11. Install the fuel tank. Tighten the six tank bolts to 11-16 ft. lbs.
12. Connect the lines and hoses. Make certain the hoses are not crimped or pinched. Make sure the clamps are correctly seated.
13. Connect the negative battery cable.

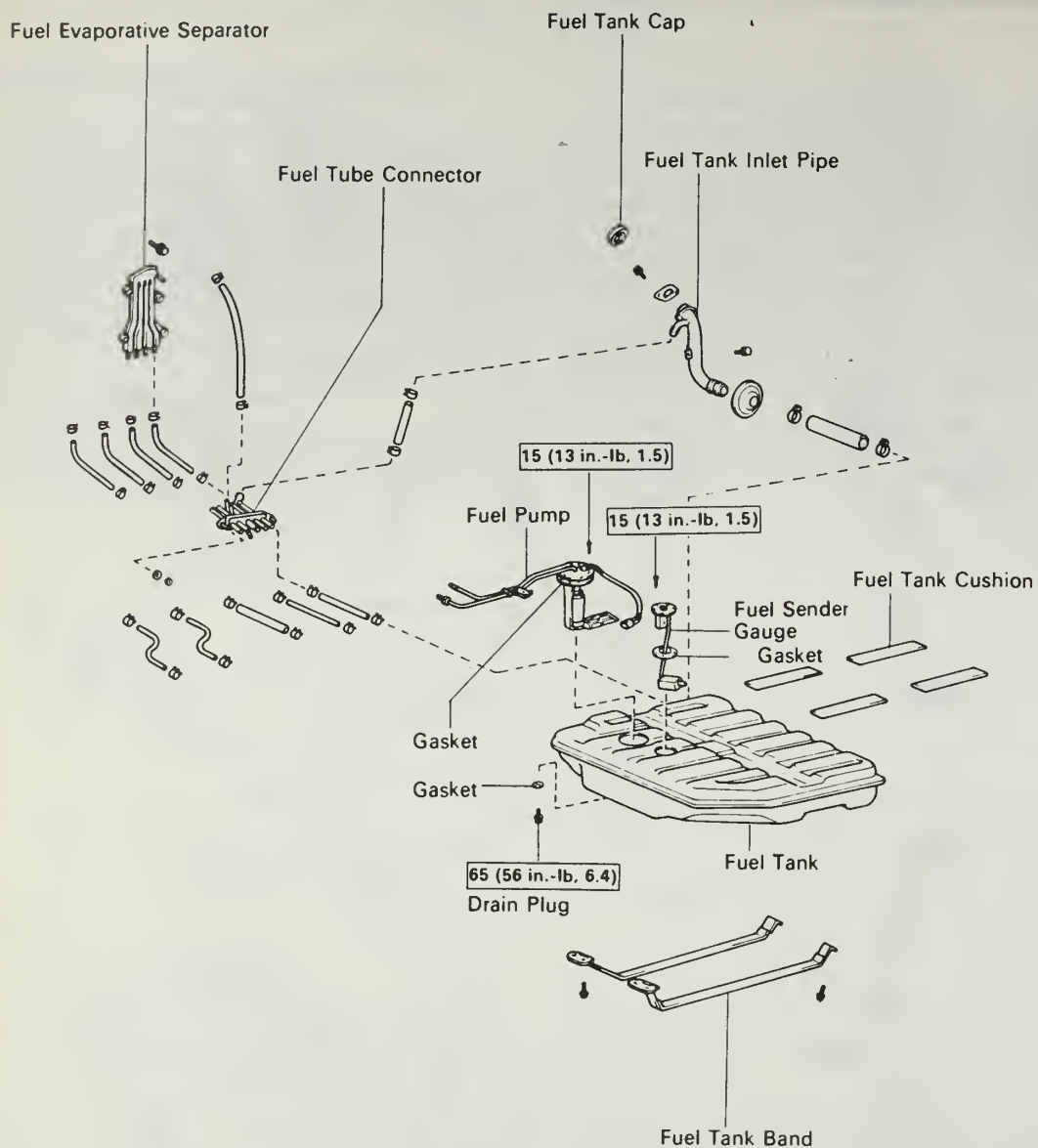


Fuel tank components — 4Runner



Fuel tank components — Trucks

5 FUEL SYSTEM



Fuel tank components — Land Cruiser

6

Chassis Electrical

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UNDERSTANDING AND TROUBLESHOOTING ELECTRICAL SYSTEMS

While it is true that electronic components should never wear out, in the real world malfunctions do occur. It is also true that any computer-based system is extremely sensitive to electrical voltages and cannot tolerate careless or haphazard testing or service procedures. An inexperienced individual can cause major damage looking for a minor problem by using the wrong kind of test equipment or connecting test leads or connectors with the ignition switch ON. When selecting test equipment, make sure the manufacturer's instructions state that the tester is compatible with whatever type of electronic control system is being serviced. Read all instructions carefully and double check all test points before installing probes or making any test connections.

The following outlines basic diagnosis techniques for dealing with computerized automotive control systems. Along with a general explanation of the various types of test equipment available to aid in servicing modern electronic automotive systems, basic repair techniques for wiring harnesses and connectors is given. Read the basic information before attempting any repairs or testing on any computer controlled system. Although the replacement and testing procedures are simple in themselves, the systems are not, and unless one has a thorough understanding of all components and their function within a particular system, the logical test sequence these systems demand cannot be followed. Minor malfunctions can make a big difference; it is important to know how each component affects the operation of the overall electronic system. This allows the ultimate cause of a problem to be found without replacing good components unnecessarily. It is not enough to use the correct test equipment; the test equipment must be used correctly.

Safety Precautions

CAUTION

Whenever working on or around any computer-based microprocessor control system, always observe these general precautions to prevent the possibility of personal injury or damage to electronic components.

- Never install or remove battery cables with the key ON or the engine running. Jumper cables should be connected with the key OFF to avoid power surges that can damage electronic control units. Engines equipped with computer controlled systems should avoid both giving and receiving jump starts due to the possibility of serious damage to components from arcing in the engine compartment when connections are made with the ignition ON.

- Always remove the battery cables before charging the battery. Never use a high output charger on an installed battery or attempt to use any type of "hot shot" (24 volt) starting aid.

- Exercise care when inserting test probes into connectors to insure good connections without damaging the connector or spreading the pins. Always probe connectors from the rear (wire) side, NOT the pin side, to avoid accidental shorting of terminals during test procedures.

- Never remove or attach wiring harness connectors with the ignition switch ON, especially to an electronic control unit.

- Do not drop any components during service procedures and never apply 12 volts directly to any component (such as a solenoid or relay) unless instructed specifically to do so. Some component electrical windings are designed to safely handle only 4 or 5 volts and can be destroyed in seconds if 12 volts are applied directly to the connector.

- Remove the electronic control unit if the vehicle is to be placed in an environment where temperatures exceed approximately 176°F (80°C), such as a paint spray booth or when welding is being performed.

ORGANIZED TROUBLESHOOTING

When diagnosing a specific problem, organized troubleshooting is a must. The complexity of a modern vehicle demands that you approach any problem in a logical, organized manner. There are certain troubleshooting techniques that are standard:

1. Establish when the problem occurs. Does the problem appear only under certain conditions? Were there any noises, odors, or other unusual symptoms? Knowing situations in which the problem does NOT occur is also helpful.

2. Isolate the problem area. To do this, make some simple tests and observations; then eliminate the systems that are working properly. Check for obvious problems such as broken wires, dirty connections or split or disconnected vacuum hoses. Always check the obvious before assuming something complicated is the cause.

3. Test for problems systematically to determine the cause once the problem area is isolated. Are all the components functioning properly? Is there power going to electrical switches and motors? Is there vacuum at vacuum switches and/or actuators? Is there a mechanical problem such as bent linkage or loose mounting screws? Doing careful, systematic checks will often turn up most causes on the first inspection without wasting time checking components that have little or no relationship to the problem.

4. Test all repairs after the work is done to make sure that the problem is fixed. Some causes can be traced to more than one component, so a careful verification of repair work is important to pick up additional malfunctions. Repairs may cause a problem to reappear or a different problem to arise. A blown fuse, for example, is a simple problem that may require more than another fuse to repair. If you don't look for a problem that caused a fuse to blow, for example, a shorted wire may go undetected.

Experience has shown that most problems tend to be the result of a fairly simple and obvious cause, such as loose or corroded connectors or air leaks in the intake system; making careful inspection of components during testing is essential to quick and accurate troubleshooting. Most components and systems can be tested with a digital volt-ohm meter (DVOM); if you're buying tools, this is one to have. Make certain it is a high-impedance meter.

NOTE: Pinpointing the exact cause of trouble in an electrical system can sometimes only be accomplished by the use of special test equipment. The following describes commonly used test equipment and explains how to put it to best use in diagnosis. In addition to the information covered below, the manufacturer's instructions provided with any test equipment should be read and clearly understood before attempting any test procedures.

TEST EQUIPMENT

Jumper Wires

Jumper wires are simple, yet extremely valuable, pieces of test equipment. Jumper wires are merely wires that are used to bypass sections of a circuit. The simplest type of jumper wire is merely a length of multi strand wire with an alligator clip at each end. Jumper wires are usually fabricated from lengths of standard automotive wire and whatever type of connector (alligator clip, spade connector or pin connector) that is required for the particular vehicle being tested. The well equipped tool box will have several different styles of jumper wires in several different lengths. Some jumper wires are made with three or more

terminals coming from a common splice for special purpose testing. In cramped, hard-to-reach areas it is advisable to have insulated boots over the jumper wire terminals in order to prevent accidental grounding, sparks, and possible fire, especially when testing fuel system components. Since many Toyota test procedures require jumpering at the Check Connector, a trip to the dealer to pick up correct terminals for the service jumper is recommended; once made, the jumpers will always be at hand when needed.

Jumper wires are used primarily to locate open electrical circuits, on either the ground side of the circuit or on the hot side. If an electrical component fails to operate, connect the jumper wire between the component and a good ground. If the component operates only with the jumper installed, the ground circuit is open. If the ground circuit is good, but the component does not operate, the circuit between the power feed and component is open. (Prevent embarrassment: make sure the switch for the circuit is turned ON.) You can sometimes connect the jumper wire directly from the battery to the hot terminal of the component, but first make sure the component uses 12 volts in operation. This type of jumpering or bridging is generally used on circuits NOT controlled by computers, such as lighting or heater circuits. Always check the wiring diagram to see what's in the circuit.

Some electrical components, such as fuel injectors, are designed to operate on about 4 volts and running 12 volts directly to the injector terminals can burn out the wiring. By inserting an in-line fuse holder between a set of test leads, a fused jumper wire can be used for bypassing open circuits. Use a 5 amp fuse to provide protection against voltage spikes. When in doubt, use a voltmeter to check the voltage input to the component and measure how much voltage is being applied normally. By moving the jumper wire successively back from the component toward the power source, you can isolate the area of the circuit where the open is located. When the component stops functioning, or the power is cut off, the open is in the segment of wire between the jumper and the point previously tested.

WARNING: Never use jumpers made from wire that is of lighter gauge than used in the circuit under test. If the jumper wire is of too small gauge, it may overheat and possibly melt. The jumper wire must be of at least the same gauge as the other wiring in the circuit being tested. Never use jumpers to bypass high resistance loads (such as motors) in a circuit. Bypassing resistances, in effect, creates a short circuit which may, in turn, cause damage and fire. Never use a jumper for anything other than temporary bypassing of components in a circuit.

12 Volt Test Light

The 12 volt test light is used to check circuits and components while electrical current is flowing through them. It is used for voltage and ground tests. Twelve volt test lights come in different styles but all have three main parts; a ground clip, a probe, and a light. The most commonly used 12 volt test lights have pick-type probes. To use a 12 volt test light, connect the ground clip to a good ground and probe wherever necessary with the pick. The pick should be sharp so that it can penetrate wire insulation to make contact with the wire, without making a large hole in the insulation. As a hint, a small flat piece of wood can be used behind the wire to prevent probing your finger.

The wrap-around light is handy in hard to reach areas or where it is difficult to support a wire to push a probe pick into it. To use the wrap around light, hook the wire to be probed with the hook and pull the trigger. A small pick will be forced through the wire insulation into the wire core.

NOTE: Do not use a test light to probe electronic ignition spark plug or coil wires. Never use a pick-type test light to probe wiring on computer controlled systems

unless specifically instructed to do so. Any wire insulation that is pierced by the test light probe should be taped and sealed with silicone after testing.

Like the jumper wire, the 12 volt test light is used to isolate opens in circuits. But, whereas the jumper wire is used to bypass the open to operate the load, the 12 volt test light is used to locate the presence of voltage in a circuit. If the test light glows, you know that there is power up to that point; if the 12 volt test light does not glow when its probe is inserted into the wire or connector, you know that there is an open circuit (no power). Move the test light in successive steps back toward the power source until the light in the handle does glow. When it does glow, the open is between the probe and point previously probed.

NOTE: NO indication of the amount of voltage present is given by the test lamp. Voltage measurement must be done with a voltmeter; the test lamp only shows that voltage is present. It is advisable before using the test light to touch its terminals across the battery posts to make sure the light is operating properly.

Self-Powered Test Light

The self-powered test light usually contains a 1.5 volt penlight battery. One type of self-powered test light is similar in design to the 12 volt test light. This type has both the battery and the light in the handle and pick-type probe tip. The second type has the light toward the open tip, so that the light illuminates the contact point. The self-powered test light is dual purpose piece of test equipment. It can be used to test for either open or short circuits when power is isolated from the circuit (continuity test). A powered test light should not be used on any computer controlled system or component unless specifically instructed to do so. Many engine sensors can be destroyed by even this small amount of voltage applied directly to the terminals.

Open Circuit Testing

To use the self-powered test light to check for open circuits, first isolate the circuit from the vehicle's 12 volt power source by disconnecting the battery or wiring harness connector. Connect the test light ground clip to a good ground and probe sections of the circuit sequentially with the test light. (start from either end of the circuit). If the light is out, the open is between the probe and the circuit ground. If the light is on, the open is between the probe and end of the circuit toward the power source.

Short Circuit Testing

By isolating the circuit both from power and from ground, and using a self-powered test light, you can check for shorts to ground in the circuit. Isolate the circuit from power and ground. Connect the test light ground clip to a good ground and probe any easy-to-reach test point in the circuit. If the light comes on, there is a short somewhere in the circuit. To isolate the short, probe a test point at either end of the isolated circuit (the light should be on). Leave the test light probe connected and open connectors, switches, remove parts, etc., sequentially, until the light goes out. When the light goes out, the short is between the last circuit component opened and the previous circuit opened.

NOTE: The 1.5 volt battery in the test light does not provide much current. A weak battery may not provide enough power to illuminate the test light even when a complete circuit is made (especially if there are high resistances in the circuit). Always make sure that the test battery is strong. To check the battery, briefly touch the ground clip to the probe; if the light glows brightly the battery is strong enough for testing. Never use a self-powered test light to perform checks for opens or shorts

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when power is applied to the electrical system under test. The 12 volt vehicle power will quickly burn out the 1.5 volt light bulb in the test light.

Voltmeter

A voltmeter is used to measure voltage at any point in a circuit, or to measure the voltage drop across any part of a circuit. It can also be used to check continuity in a wire or circuit by indicating current flow from one end to the other. Voltmeters usually have various scales on the meter dial and a selector switch to allow the selection of different voltage ranges. The voltmeter has a positive and a negative lead. To avoid damage to the meter, always connect the negative lead to the negative side of circuit and connect the positive lead to the positive side of the circuit. Note that the negative voltmeter lead will always be black and that the positive voltmeter will always be some color other than black (usually red). Depending on how the voltmeter is connected into the circuit, it has several uses.

A voltmeter can be connected either in parallel or in series with a circuit and it has a very high resistance to current flow. When connected in parallel, only a small amount of current will flow through the voltmeter current path; the rest will flow through the normal circuit current path and the circuit will work normally. When the voltmeter is connected in series with a circuit, only a small amount of current can flow through the circuit. The circuit will not work properly, but the voltmeter reading will show if the circuit is complete or not.

Available Voltage Measurement

Set the voltmeter selector switch to the scale nearest but above 12v (commonly, the 20V position) and connect the meter negative lead to the negative post of the battery. Connect the positive meter lead to the positive post of the battery and turn the ignition switch ON to provide a load. Read the voltage on the meter or digital display. A well charged battery should register over 12 volts. If the meter reads below 11.5 volts, the battery power may be insufficient to operate the electrical system properly. This test determines voltage available from the battery and should be the first step in any electrical trouble diagnosis procedure. Many electrical problems, especially on computer controlled systems, can be caused by a low state of charge in the battery. Excessive corrosion at the battery cable terminals can cause a poor contact that will prevent proper charging and full battery current flow.

Normal battery voltage is approximately 12 volts when fully charged. When the battery is supplying current to one or more circuits it is said to be "under load". When everything is OFF, the electrical system is under a "no-load" condition. A fully charged battery may show about 12.5 volts at no load; will drop to 12 volts under medium load; and will drop even lower under heavy load. If the battery is partially discharged, the voltage decrease under heavy load may be excessive, even though the battery shows 12 volts or more at no load. When allowed to discharge further, the battery's available voltage under load will decrease more severely. For this reason, it is important that the battery be fully charged during all testing procedures to avoid errors in diagnosis and incorrect test results.

Voltage Drop

When current flows through a resistance, the voltage beyond the resistance is reduced (the larger the current or amperage, the greater the reduction in voltage). When no current is flowing, there is no voltage drop because there is no current flow. All points in the circuit which are connected to the power source are at the same voltage as the power source. The total voltage drop always equals the total source voltage. In a long circuit with many connectors, a series of small, unwanted voltage drops due to corrosion at the connectors can add up to a total loss of voltage which impairs the operation of the normal loads in the circuit.

INDIRECT COMPUTATION OF VOLTAGE DROPS

1. Set the voltmeter selector switch to the 20 volt position.
2. Connect the meter negative lead to a good ground.
3. Probe all resistances in the circuit with the positive meter lead.
4. Operate the circuit in all modes and observe the voltage readings.

DIRECT MEASUREMENT OF VOLTAGE DROPS

1. Set the voltmeter switch to the 20 volt position.
2. Connect the voltmeter negative lead to the ground side of the resistance load to be measured.
3. Connect the positive lead to the positive side of the resistance or load to be measured.
4. Read the voltage drop directly on the 20 volt scale.

Too high a voltage indicates too high a resistance. If, for example, a blower motor runs too slowly, you can determine if there is too high a resistance in the resistor pack. By taking voltage drop readings in all parts of the circuit, you can isolate the problem. Too low a voltage drop indicates too low a resistance. If, for example, a blower motor runs too fast in the MED and/or LOW position, the problem can be isolated in the resistor pack by taking voltage drop readings in all parts of the circuit to locate a possibly shorted resistor. The maximum allowable voltage drop under load is critical, especially if there is more than one high resistance problem in a circuit because all voltage drops are cumulative. A small drop is normal due to the resistance of the conductors.

HIGH RESISTANCE TESTING

1. Set the voltmeter selector switch to the 4 volt position.
2. Connect the voltmeter positive lead to the positive post of the battery.
3. Turn the ignition switch ON but do not start the engine. Turn on the headlights or heater blower to provide a load.
4. Probe various points in the circuit with the negative voltmeter lead.
5. Read the voltage drop on the 4 volt scale.

NOTE: Voltage drops are all measured while a load is operating; without a current flow, there will be no voltage drop.

Ohmmeter

The ohmmeter is designed to read resistance (ohms) in a circuit or component. Although there are several different styles of ohmmeters, all will usually have a selector switch which permits the measurement of different ranges of resistance (usually the selector switch allows the multiplication of the meter reading by 10, 100, 1000, and 10,000). A calibration knob allows the meter to be set at zero for accurate measurement. Since all ohmmeters are powered by an internal battery (usually 9 volts), the ohmmeter can be used as a self-powered test light. When the ohmmeter is connected, current from the ohmmeter flows through the circuit or component being tested. Since the ohmmeter's internal resistance and voltage are known values, the amount of current flow through the meter depends on the resistance of the circuit or component being tested.

The ohmmeter can be used to perform continuity test for opens or shorts (either by observation of the meter needle or as a self-powered test light), and to read actual resistance in a circuit. It should be noted that the ohmmeter is used to check the resistance of a component or wire while there is no voltage applied to the circuit. This means the circuitry MUST be isolated from the power source before testing.

NOTE: When checking diodes or other solid state components, the ohmmeter leads can only be connected one way in order to measure current flow in a single direction. Make sure the positive and negative terminal connections are as described in the test procedures to verify the one-way diode operation.

In using the meter for making continuity checks, do not be concerned with the actual resistance readings. Zero resistance, or any resistance readings, indicate continuity in the circuit. Infinite resistance indicates an open in the circuit. A high resistance reading where there should be none indicates a problem in the circuit. Checks for short circuits are made in the same manner as checks for open circuits except that the circuit must be isolated from both power and normal ground. Infinite resistance indicates no continuity to ground, while zero resistance indicates a dead short to ground.

RESISTANCE MEASUREMENT

The batteries in an ohmmeter will weaken with age and temperature, so the ohmmeter must be calibrated or "zeroed" before taking measurements. To zero the meter, place the selector switch in its lowest range and touch the two ohmmeter leads together. Turn the calibration knob until the meter needle is exactly on zero.

NOTE: All analog (needle) type ohmmeters must be zeroed before use, but some digital ohmmeter models are automatically calibrated when the switch is turned on. Self-calibrating digital ohmmeters do not have an adjusting knob, but its a good idea to check for a zero readout before use by touching the leads together. All computer controlled systems require the use of a digital ohmmeter with at least 10 megohms impedance for testing. Before any test procedures are attempted, make sure the ohmmeter used is compatible with the electrical system or damage to the on-board computer could result.

To measure resistance, isolate the circuit from the vehicle power source by disconnecting the battery cables or the harness connector. Make sure the key is OFF when disconnecting any components or the battery. Where necessary, also isolate at least one side of the circuit to be checked to avoid reading parallel resistances. Parallel circuit resistances will always give a lower reading than the actual resistance of either of the branches. Connect the meter leads to both sides of the circuit (wire or component) and read the actual measured ohms on the meter scale. Make sure the selector switch is set to the proper ohm scale for the circuit being tested to avoid misreading the ohmmeter test value.

WARNING: Never use an ohmmeter with power applied to the circuit. Like the self-powered test light, the ohmmeter is designed to operate on its own power supply. The normal 12 volt automotive electrical system current could damage the meter

Ammeters

An ammeter measures the amount of current flowing through a circuit in units called amperes or amps. Amperes are units of electron flow which indicate how fast the electrons are flowing through the circuit. Since Ohms Law dictates that current flow in a circuit is equal to the circuit voltage divided by the total circuit resistance, increasing voltage also increases the current level (amps).

Likewise, any decrease in resistance will increase the amount of amps in a circuit. At normal operating voltage, most circuits have a characteristic amount of amperes, called "current draw" which can be measured using an ammeter. By referring to a specified current draw rating, measuring the amperes, and comparing the two values, one can determine what is happening within the circuit to aid in diagnosis. An open circuit, for example, will not allow any current to flow so the ammeter reading will be zero. More current flows through a heavily loaded circuit or when the charging system is operating.

An ammeter is always connected in series with the circuit being tested. All of the current that normally flows through the circuit must also flow through the ammeter; if there is any other

path for the current to follow, the ammeter reading will not be accurate. The ammeter itself has very little resistance to current flow and therefore will not affect the circuit, but it will measure current draw only when the circuit is closed and electricity is flowing. Excessive current draw can blow fuses and drain the battery, while a reduced current draw can cause motors to run slowly, lights to dim and other components to not operate properly. The ammeter can help diagnose these conditions by locating the cause of the high or low reading.

If you're considering buying an ohmmeter, look for one of the inductive types; these are more expensive but can be clamped around a wire rather than being wired into the circuit. These ammeters only work on a single conductor, so it may be necessary to open a wire harness, but this is still better than having to cut or disconnect wires.

Multi-meters

Different combinations of test meters can be built into a single unit designed for specific tests. Some of the more common combination test devices are known as Volt/Amp testers, Tach/Dwell meters, Volt-Ohm meters or Digital Multi-meters. The Volt/Amp tester is used for charging system, starting system or battery tests and consists of a voltmeter, an ammeter and a variable resistance carbon pile. The voltmeter will usually have at least two ranges for use with 6, 12 and 24 volt systems. The ammeter also has more than one range for testing various levels of battery loads and starter current draw and the carbon pile can be adjusted to offer different amounts of resistance. The Volt/Amp tester has heavy leads to carry large amounts of current and many later models have an inductive ammeter pickup that clamps around the wire to simplify test connections. On some models, the ammeter also has a zero-center scale to allow testing of charging and starting systems without switching leads or polarity. A digital multi-meter is a voltmeter and ohmmeter combined in an instrument which gives a digital readout. These are often used when testing solid state circuits because of their high input impedance (usually 10 megohms or more).

The tach/dwell meter combines a tachometer and a dwell (cam angle) meter and is a specialized kind of voltmeter. The tachometer scale is marked to show engine speed in rpm and the dwell scale is marked to show degrees of distributor shaft rotation. In most electronic ignition systems, dwell is determined by the control unit, but the dwell meter can also be used to check the duty cycle (operation) of some electronic engine control systems. Some tach/dwell meters are powered by an internal battery, while others take their power from the truck battery in use. The battery powered testers usually require calibration much like an ohmmeter before testing.

Wiring Harnesses

The average automobile contains about ½ mile of wiring, with hundreds of individual connections. To protect the many wires from damage and to keep them from becoming a confusing tangle, they are organized into bundles, enclosed in plastic or taped together and called wire harnesses. Different wiring harnesses serve different parts of the vehicle. Individual wires are color coded to help trace them through a harness where sections are hidden from view.

A loose or corroded connection or a replacement wire that is too small for the circuit will add extra resistance and an additional voltage drop to the circuit. A ten percent voltage drop can result in slow or erratic motor operation, for example, even though the circuit is complete. Automotive wiring or circuit conductors can be in any one of three forms:

1. Single strand wire.
2. Multi-strand wire.
3. Printed circuitry.

Single strand wire has a solid metal core and is usually used inside such components as alternators, motors, relays and other

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devices. Multi-strand wire has a core made of many small strands of wire twisted together into a single conductor. Most of the wiring in an automotive electrical system is made up of multi-strand wire, either as a single conductor or grouped together in a harness. All wiring is color coded on the insulator, either as a solid color or as a colored wire with an identification stripe. A printed circuit is a thin film of copper or other conductor that is printed on an insulator backing. Occasionally, a printed circuit is sandwiched between two sheets of plastic for more protection and flexibility. A complete printed circuit, consisting of conductors, insulating material and connectors for lamps or other components is called a printed circuit board. Printed circuitry is used in place of individual wires or harnesses in places where space is limited, such as behind instrument panels.

Wire Gauge

Since computer controlled automotive electrical systems are very sensitive to changes in resistance, the selection of properly sized wires is critical when systems are repaired. The wire gauge number is an expression of the cross section area of the conductor. The most common system for expressing wire size is the American Wire Gauge (AWG) system.

Wire cross section area is measured in circular mils. A mil is 1/1000 in. (0.001 in.); a circular mil is the area of a circle one mil in diameter. For example, a conductor 1/4 in. in diameter is 0.250 in. or 250 mils. The circular mil cross section area of the wire is 250 squared or 62,500 circular mils. Imported truck models usually use metric wire gauge designations, which is simply the cross section area of the conductor in square millimeters.

Gauge numbers are assigned to conductors of various cross section areas. As gauge number increases, area decreases and the conductor becomes smaller. A 5 gauge conductor is smaller than a 1 gauge conductor and a 10 gauge is smaller than a 5 gauge. As the cross section area of a conductor decreases, resistance increases and so does the gauge number. A conductor with a higher gauge number will carry less current than a conductor with a lower gauge number.

NOTE: Gauge wire size refers to the size of the conductor, not the size of the complete wire. It is possible to have two wires of the same gauge with different diameters because one may have thicker insulation than the other.

Most automotive electrical systems use 10, 12, 14, 16 and 18 gauge wire. Main power distribution circuits and larger accessories usually use 10 and 12 gauge wire. Battery cables are usually 4 or 6 gauge, although 1 and 2 gauge wires are occasionally used. Wire length must also be considered when making repairs to a circuit. As conductor length increases, so does resistance. An 18 gauge wire, for example, can carry a 10 amp load for 10 feet without excessive voltage drop; however if a 15 foot wire is required for the same 10 amp load, it must be a 16 gauge wire.

An electrical schematic shows the electrical current paths when a circuit is operating properly. It is essential to understand how a circuit works before trying to figure out why it doesn't. Schematics break the entire electrical system down into individual circuits and show only one particular circuit. In a schematic, no attempt is made to represent wiring and components as they physically appear on the vehicle; switches and other components are shown as simply as possible. Face views of harness connectors show the cavity or terminal locations in all multi-pin connectors to help locate test points.

If you need to backprobe a connector while it is on the component, the order of the terminals must be mentally reversed. The wire color code can help in this situation, as well as a keyway, lock tab or other reference mark.

WIRING REPAIR

Soldering is a quick, efficient method of joining metals perma-

nently. Everyone who has the occasion to make wiring repairs should know how to solder. Electrical connections that are soldered are far less likely to come apart and will conduct electricity much better than connections that are only "pig-tailed" together. The most popular (and preferred) method of soldering is with an electrical soldering gun. Soldering irons are available in many sizes and wattage ratings. Irons with higher wattage ratings deliver higher temperatures and recover lost heat faster. A small soldering iron rated for no more than 50 watts is recommended, especially on electrical systems where excess heat can damage the components being soldered.

There are three ingredients necessary for successful soldering; proper flux, good solder and sufficient heat. A soldering flux is necessary to clean the metal of tarnish, prepare it for soldering and to enable the solder to spread into tiny crevices. When soldering, always use a resin flux or resin core solder which is non-corrosive and will not attract moisture once the job is finished. Other types of flux (acid core) will leave a residue that will attract moisture and cause the wires to corrode. Tin is a unique metal with a low melting point. In a molten state, it dissolves and alloys easily with many metals. Solder is made by mixing tin with lead. The most common proportions are 40/60, 50/50 and 60/40, with the percentage of tin listed first. Low priced solders usually contain less tin, making them very difficult for a beginner to use because more heat is required to melt the solder. A common solder is 40/60 which is well suited for all-around general use, but 60/40 melts easier, has more tin for a better joint and is preferred for electrical work.

Soldering Techniques

Successful soldering requires that the metals to be joined be heated to a temperature that will melt the solder—usually 360-460°F (182-238°C). Contrary to popular belief, the purpose of the soldering iron is not to melt the solder itself, but to heat the parts being soldered to a temperature high enough to melt the solder when it is touched to the work.

NOTE: Soldering tips are made of copper for good heat conductivity, but must be "tinned" regularly for quick transference of heat to the project and to prevent the solder from sticking to the iron. To "tin" the iron, simply heat it and touch the flux-cored solder to the tip; the solder will flow over the hot tip. Wipe the excess off with a clean rag, but be careful as the iron will be hot.

After some use, the tip may become pitted. If so, simply dress the tip smooth with a smooth file and "tin" the tip again. An old saying holds that "metals well cleaned are half soldered." Flux-cored solder will remove oxides but rust, bits of insulation and oil or grease must be removed with a wire brush or emery cloth. For maximum strength in soldered parts, the joint must start off clean and tight. Weak joints will result in gaps too wide for the solder to bridge.

If a separate soldering flux is used, it should be brushed or swabbed on only those areas that are to be soldered. Most solders contain a core of flux and separate fluxing is unnecessary. Hold the work to be soldered firmly. It is best to solder on a wooden board, because a metal vise will only rob the piece to be soldered of heat and make it difficult to melt the solder. Hold the soldering tip with the broadest face against the work to be soldered. Apply solder under the tip close to the work, using enough solder to give a heavy film between the iron and the piece being soldered, while moving slowly and making sure the solder melts properly. Keep the work level or the solder will run to the lowest part and favor the thicker parts, because these require more heat to melt the solder. If the soldering tip overheats (the solder coating on the face of the tip burns up), it should be re-tinned. Once the soldering is completed, let the soldered joint stand until cool. Tape and seal all soldered wire splices after the repair has cooled.

NOTE: Soldering often becomes a "three-handed" job, particularly if working in the vehicle instead of on the workbench. If an assistant is not available, many small soldering aids may be purchased. These have an assortment of clips and holders to support the work while you deal with the soldering iron and the solder roll.

Wire Harness and Connectors

The on-board computer (ECM) wire harness electrically connects the control unit to the various solenoids, switches and sensors used by the control system. Most connectors in the engine compartment or otherwise exposed to the elements are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels used by the computer and sensors. All connectors have a lock which secures the male and female terminals together, with a secondary lock holding the seal and terminal into the connector. Both terminal locks must be released when disconnecting ECM connectors.

Molded-on connectors require complete replacement of the connection. This means splicing a new connector assembly into the harness. All splices in on-board computer systems should be soldered to insure proper contact. Use care when probing the connections or replacing terminals in them as it is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage components. Always use jumper wires between connectors for circuit checking and never probe through weatherproof seals.

Open circuits are often difficult to locate by sight because corrosion or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit or a failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections. When using a circuit tester for diagnosis, always probe connections from the wire side. Be careful not to damage sealed connectors with test probes.

All wiring harnesses should be replaced with identical parts, using the same gauge wire and connectors. When signal wires are spliced into a harness, use wire with high temperature insulation only. With the low voltage and current levels found in the system, it is important that the best possible connection at all wire splices be made by soldering the splices together. It is seldom necessary to replace a complete harness. If replacement is necessary, pay close attention to insure proper harness routing. Secure the harness with suitable plastic wire clamps to prevent vibrations from causing the harness to wear in spots or contact any hot components.

NOTE: Weatherproof connectors cannot be replaced with standard connectors. Instructions are provided with replacement connector and terminal packages. Some wire harnesses have mounting indicators (usually pieces of colored tape) to mark where the harness is to be secured.

Wires which are open, exposed or otherwise damaged are repaired by simple splicing. Where possible, if the wiring harness is accessible and the damaged place in the wire can be located, it is best to open the harness and check for all possible damage. In an inaccessible harness, the wire must be bypassed with a new insert, usually taped to the outside of the old harness.

When replacing fusible links, be sure to use fusible link wire, NOT ordinary automotive wire. Make sure the fusible segment is of the same gauge and construction as the one being replaced

and double the stripped end when crimping the terminal connector for a good contact. The melted (open) fusible link segment of the wiring harness should be cut off as close to the harness as possible, then a new segment spliced in as described. In the case of a damaged fusible link that feeds two harness wires, the harness connections should be replaced with two fusible link wires so that each circuit will have its own separate protection.

NOTE: Most of the problems caused in the wiring harness are due to bad ground connections. Always check all vehicle ground connections for corrosion or looseness before performing any power feed checks to eliminate the chance of a bad ground affecting the circuit.

Repairing Hard Shell Connectors

Unlike molded connectors, the terminal contacts in hard shell connectors can be replaced. Weatherproof hard-shell connectors with the leads molded into the shell have non-replaceable terminal ends. Replacement usually involves the use of a special terminal removal tool that depress the locking tangs (barbs) on the connector terminal and allow the connector to be removed from the rear of the shell. The connector shell should be replaced if it shows any evidence of burning, melting, cracks, or breaks. Replace individual terminals that are burnt, corroded, distorted or loose.

NOTE: The insulation crimp must be tight to prevent the insulation from sliding back on the wire when the wire is pulled. The insulation must be visibly compressed under the crimp tabs, and the ends of the crimp should be turned in for a firm grip on the insulation.

The wire crimp must be made with all wire strands inside the crimp. The terminal must be fully compressed on the wire strands with the ends of the crimp tabs turned in to make a firm grip on the wire. Check all connections with an ohmmeter to insure a good contact. There should be no measurable resistance between the wire and the terminal when connected.

Mechanical Test Equipment

Vacuum Gauge

Most gauges are graduated in inches of mercury (in.Hg), although a device called a manometer reads vacuum in inches of water (in. H₂O). The normal vacuum reading usually varies between 18 and 22 in.Hg at sea level. To test engine vacuum, the vacuum gauge must be connected to a source of manifold vacuum. Many engines have a plug in the intake manifold which can be removed and replaced with an adapter fitting. Connect the vacuum gauge to the fitting with a suitable rubber hose or, if no manifold plug is available, connect the vacuum gauge to any device using manifold vacuum, such as EGR valves, etc. The vacuum gauge can be used to determine if enough vacuum is reaching a component to allow its actuation.

Hand Vacuum Pump

Small, hand-held vacuum pumps come in a variety of designs. Most have a built-in vacuum gauge and allow the component to be tested without removing it from the vehicle. Operate the pump lever or plunger to apply the correct amount of vacuum required for the test specified in the diagnosis routines. The level of vacuum in inches of Mercury (in.Hg) is indicated on the pump gauge. For some testing, an additional vacuum gauge may be necessary. Sooner or later, you'll need a vacuum gauge; buy a high quality one which will last.

HEATING AND AIR CONDITIONING

The heater core is a small heat exchanger located inside the car, similar to the radiator at the front of the car. Coolant is circulated from the engine through the heater core and back to the engine. The heater fan blows fresh, outside air through the heater core; the air is heated and sent on to the interior of the car.

About the only time the heater core will need removal is for replacement due to clogging or leaking. Thankfully, this doesn't happen too often; removing the heater core can be a major task. Some are easier than others, but all require working in unusual positions inside the car and fitting tools into very cramped quarters behind the dashboard. In some cases, the dashboard must be removed during the procedure—another major project.

NOTE: On models equipped with air conditioning, the heater and air conditioner are adjacent but completely separate units. Be certain when working under the dashboard that only the heater hoses are disconnected. The air conditioning hoses are under pressure. If disconnected, the escaping refrigerant will freeze any surface with which it comes in contact, including your skin and eyes. Refer all air conditioning work to a qualified mechanic.

Heater Unit

The heater unit, blower motor and heater core are all removed as a unit. Heater core and blower motor removal procedures are detailed within these procedures.

REMOVAL AND INSTALLATION

1. Drain the cooling system.

WARNING: Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

2. Disconnect the hoses to the heater core. Identify each one so that it may be correctly reinstalled.
3. Remove the glove box assembly.
4. At the heater case under the dash, disconnect the ductwork from the case.

5. Disconnect the heater control cables from the heater case. Lift the spring clip holding the control cable to allow the cable to be manipulated. Don't deform or crimp the cables.

6. Disconnect the wiring harness to the blower fan.

7. Remove the three or four bolts holding the heater case to the dash. Because the inlet tubes project through the firewall, the unit will not fall straight down. It will need to be pulled into the passenger compartment and then brought downward.

8. To remove the blower fan, remove the three bolts holding the fan assembly to the case and lift the fan and motor out of the case.

9. The heater core may be removed from the case. Do not damage any of the air control doors or foam insulation while removing the core.

To install:

10. Reassemble the core into the case, making certain the foam insulation isn't damaged.

11. Lift the case into position and carefully place the inlet and outlet pipes through the firewall. Install the retaining bolts holding the case to the dash.

12. Connect the wiring harness to the blower fan.

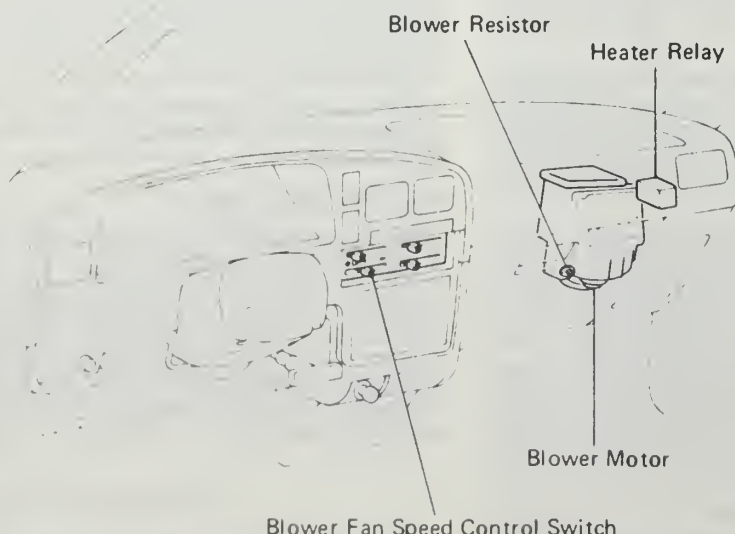
13. Connect the control cables to their linkages. Each must be adjusted so that the motion of the dashboard lever causes the correct corresponding motion in the air door. Both the control lever and the door must reach maximum travel at the same time if full function is to be achieved.

- a. Set the dashboard control to FRESH. Lift the adjustment clip and adjust the truck and 4Runner air inlet cable towards the heater unit until the linkage is at its maximum travel. For Land Cruiser, adjust the cable away from the case. Release the adjustment clip.

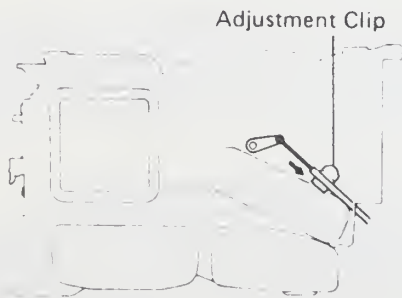
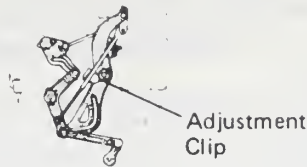
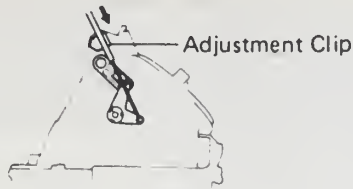
- b. Set the dashboard control to VENT (trucks) or DEF (4Runner and Land Cruiser). Lift the adjustment clip and adjust the air flow control cable towards the heater unit until the linkage is at its maximum travel. Release the adjustment clip.

- c. Set the temperature control to COOL. Lift the adjustment clip and adjust the truck and 4Runner air mix control damper control cable away from the heater case until the linkage is at its maximum travel. For Land Cruiser, adjust the cable towards the case.

14. Connect or reinstall the ductwork. Make certain each tube is firmly and completely fitted on its port. A light spray of glass cleaner serves as a good lubricant; don't use too much.



Heater components — truck and 4Runner



Adjusting the air inlet control cable (upper), the air flow control cable (center) and the air mix control cable on trucks and 4Runners

15. Install the glove box.
16. Connect the heater hoses. Use new clamps.
17. Refill the coolant.

Heater Control Valve (Water Valve)

The heater control valve is located under the hood near the firewall. It is operated by a cable connected to the dashboard temperature control. The valve is opened to admit hot coolant into the heater core when the operator moves the lever into the warm or hot range.

REMOVAL AND INSTALLATION

1. Drain the engine coolant.

WARNING: Housepets and small animals are attracted to the odor and taste of engine coolant (antifreeze). It is a highly poisonous mixture of chemicals; special care must be taken to protect open containers and spillage.

2. Disconnect the control cable from the valve.
3. Disconnect the inlet and outlet hoses from the valve.
4. If the valve is held by a retaining bolt, remove it and remove the valve.

5. Reinstall in reverse order. Use new hose clamps.
6. Move the temperature selector lever to COOL. Adjust the valve lever to the corresponding position and connect the cable. Lift the spring clip and adjust the cable so that the valve achieves full travel to the closed position.
7. Refill the coolant.

Heater Controls

REMOVAL AND INSTALLATION

NOTE: These procedures allow the control unit to be pulled forward out of the dash. Generally, this is sufficient to allow inspection of the lever functions, etc. If the control head is to be removed, the cables must be disconnected from each lever. In some cases, it may be easier to disconnect the cable at the heater linkage and pull the cable through the dash.

Trucks and 4Runner

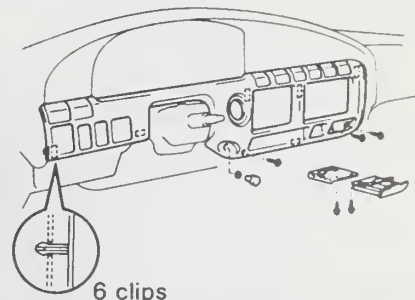
1. Remove the trim panel surrounding the controls.
2. Remove the knobs from the control levers. These knobs do pull off, although often with great effort. Don't damage anything when exerting force on the knob.
3. If equipped with air conditioning, remove the A/C switch.
4. Use a thin, flat bladed tool with a protected or taped edge. Carefully work the blade into the area at the bottom of the control unit and pry it out.
5. Gently pull the unit forward. If equipped with a clock in the housing, disconnect the clock. Disconnect the lighting harness and pull the control unit forward.
6. Install in reverse order, making sure the electrical connectors are connected before installing the unit. Install the knobs securely and install the trim panel.

1989-90 Land Cruiser

1. Remove the heater control lever knobs. Remove the ash tray.
2. Remove the 5 screws holding the trim panel surrounding the heater controls. The panel is also held by 2 concealed clips at the lower left and upper right corners; loosen them and remove the trim panel.
3. Disconnect any wiring connectors to the trim panel.
4. Remove the four retaining screws. Remove the heater control panel and the spacer.
5. Disconnect the wiring connectors and remove the center vent.

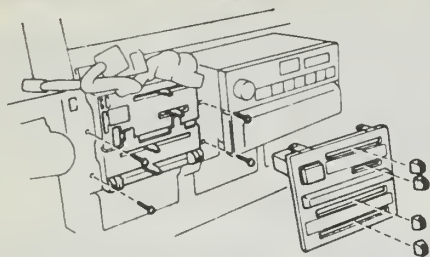
To install:

6. Assemble the controller, connect the wiring and fit the assembly into the dash. Install the retaining screws.
7. Install the center vent.
8. Install the trim panel; make certain each clip is correctly seated.
9. Install the ash tray and install the control knobs.



Removing the instrument panel trim — 1991 Land Cruiser

6 CHASSIS ELECTRICAL



Heater control unit — 1991 Land Cruiser 1991 Land Cruiser

1. Remove the ashtray. Remove the ashtray holder.
2. Remove the 3 screws holding the lower instrument panel trim. The trim panel is also held by six clips; each must be gently pried loose.

WARNING: The trim panel is long and thin; it is easily broken by rough handling.

3. Once the panel is loose, disconnect the wiring connectors to the switches and remove the panel from the area.
4. Remove the knobs from the heater control levers.
5. Remove the heater faceplate.
6. Remove the four screws and pull the heater control unit forward and out of the dash.

To install:

7. Fit the control unit into the dash and install the retaining screws.
8. Install the faceplate and install the knobs on the controller.
9. Hold the large dash panel in place and connect the wiring connectors to each switch.
10. Install the trim by aligning all the clips at once and gently pushing each into place. Install the retaining screws.
11. Install the ashtray holder and ashtray.

Heater Blower Motor

The blower motor and fan is mounted in the bottom of the heater case. Depending on model and equipment, it may be pos-

sible to remove the blower without removing the heater case. If there is insufficient clearance below the case to get the motor and fan free, the case must be removed.

1. Disconnect the electrical harness from the blower motor.
2. Disconnect the ductwork from the casing if it will interfere with motor removal. The motor may have a smaller, flexible air exchange hose on it; remove it.
3. Remove the blower motor fasteners and lower the blower motor out of the heater case.
4. Install the motor into the inlet duct. Be sure to position the motor so that the flexible tube can be attached to the motor and connect it. Install or connect any ductwork removed from the heater case.
5. Connect the electrical lead, check the coolant level, run the heater and check for any leaks.

Evaporator Core, Expansion Valve and Thermostat

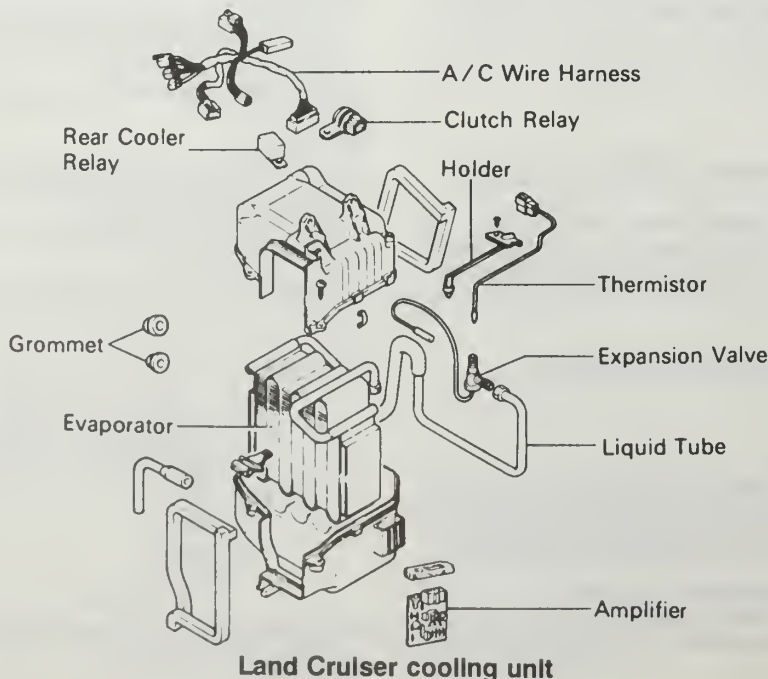
The interior air conditioning components are all contained in a single cooling unit adjacent to the heater case. The cooling unit is removed as a unit and carefully disassembled on the workbench, giving access to the evaporator, expansion valve, thermostat (thermistors), and on some vehicles, the pressure switch and signal amplifier.

Anytime an air conditioning line is loosened or disconnected, the O-ring must be replaced. Make certain the ring is correctly installed before reassembly.

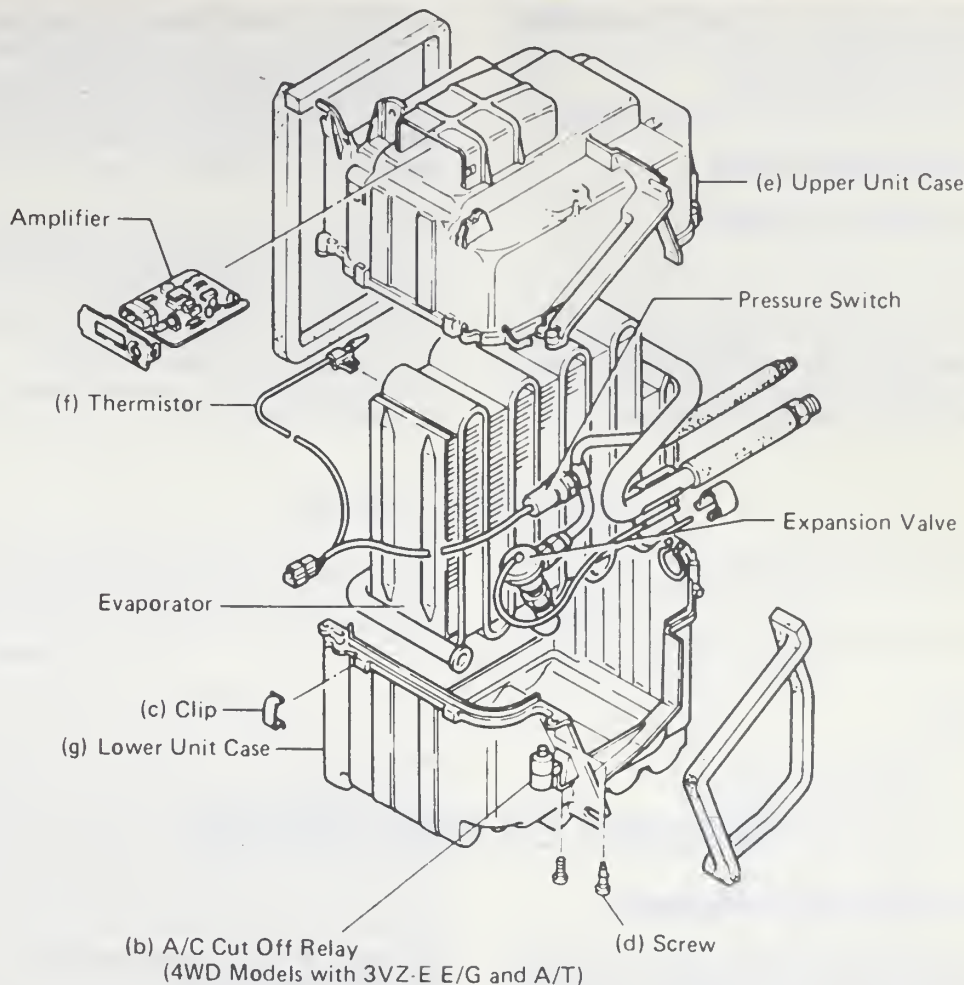
CAUTION

PLEASE RE-READ THE AIR CONDITIONING SECTION IN SECTION ONE SO THAT THE SYSTEM MAY BE DISCHARGED PROPERLY. ALWAYS WEAR EYE PROTECTION AND GLOVES WHEN DISCHARGING THE SYSTEM. OBSERVE NO SMOKING/NO OPEN FLAME RULES.

1. Disconnect the negative battery cable.
2. Safely discharge the air conditioning system.
3. Disconnect the suction hose (large hose) at the cooling unit outlet at the firewall. Use two wrenches to counterhold the fitting while loosening. Cap the hose to keep out dirt and moisture.
4. Disconnect the liquid line (small tube) at the cooling unit



Land Cruiser cooling unit



Cooling unit – truck and 4Runner

inlet fitting at the firewall. Use two wrenches to counterhold the fitting while loosening. Cap the hose to keep out dirt and moisture.

5. Remove the grommet(s) from around the fittings.
6. Inside the vehicle, remove the glove box.
7. Disconnect the electrical connectors.
8. Remove the hardware holding the cooling unit. Pay attention to which nut, bolt or screw can out of each location; exact reinstallation is required. Pull the case back from the firewall and then lower it. Place the unit upright on the workbench.
9. Remove or disconnect any external wiring on the case of the unit. On 4WD trucks with 3VZ-E and automatic transmission, remove the cut-off relay from the bottom of the cooling unit case.
10. Remove the clips holding the two halves together. Remove the screws.
11. Carefully lift the upper half of the case off the unit.
12. Carefully unplug and remove the thermistor from the unit.
13. Remove the lower case.
14. If desired, disconnect the liquid tube from the inlet fitting of the expansion valve. Remove the insulation and heat sensing tube from the suction tube.
15. Disconnect the expansion valve. Use two wrenches and don't bend the pipes.
16. Inspect the evaporator core, looking for bent fins. If the core is clogged, clean it with compressed air or a soft, dry brush. Never use water to clean the core. Closely inspect the threaded fittings for any sign of cracking or deformation.

To install:

17. Install the components onto the evaporator.
 - a. For Land Cruiser and Trucks, connect the expansion valve to the inlet fitting of the evaporator. Make certain a new O-ring is placed on the tube fitting. Tighten the nut to 17 ft. lbs. (23 Nm). Connect the liquid tube to the inlet fitting of the expansion valve; tighten the nut to 10 ft. lbs. (13 Nm). For Land Cruiser, install the thermistor onto the evaporator.
 - b. For 4Runner, install the expansion valve, suction and liquid tubes to the evaporator, using new O-rings. Tighten the fittings to 48 inch lbs. (5.4 Nm). Install the holder to the tubes with the heat sensing tube.
 - c. Install the lower unit case onto the evaporator.
 - d. For Truck and 4Runner, install the thermistor.
 - e. Install the upper case on the unit. Install the clips and hardware in their exact original locations.
 - f. Install the wiring harness. Double check the connectors for correct placement and secure fit.
18. Lift the cooling unit into place and secure the retaining nuts, bolts and screws. On Land Cruiser, it's easier to connect the wire harness before lifting the unit into place. Make certain the harness is not pinched during installation.
19. For Truck and 4Runner, connect the wiring harness.
20. Install the glove box.
21. Under the hood, install the grommet(s) on the cooling unit fittings. Make certain the grommet(s) fit correctly.
22. Connect the liquid tube to the cooling unit inlet and tighten the fitting to 10 ft. lbs. (13 Nm).

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23. Connect the suction hose to the outlet fitting and tighten the fitting to 24 ft. lbs. (32 Nm).
24. Connect the negative battery cable.
25. Evacuate the air conditioning system.
26. Recharge the system, operate it and check for leaks.

Receiver/Dryer

REMOVAL AND INSTALLATION

1. The receiver/dryer is located under the hood, generally near the condenser at the front of the vehicle. Before removal, inspect the sight glass, fusible plug and line fittings for signs of leakage. A leak will leave light traces of compressor oil; the oil in turn will collect and hold dirt, making the area easy to find.

2. Safely discharge the air conditioning system.
3. Disconnect the two liquid tubes from the receiver/dryer.
4. Remove the unit from its holder.
5. The unit cannot be repaired; it must be replaced. Always replace the receiver/dryer if the system has been open or discharged for any length of time. Moisture within the system can render the dryer element useless.

To install:

6. Place the receiver/dryer into its holder and secure it.
7. Connect the two liquid lines, using new O-rings. Tighten the fittings to 10 ft. lbs. (13 Nm).
8. If the receiver was replaced with a new unit, add 20cc (0.7 oz) of compressor oil to the compressor.
9. Evacuate the system.
10. Recharge the system with refrigerant. Operate the system and check for leaks.

AUXILIARY OR REAR HEATER

Land Cruiser and 4Runner

Certain Land Cruiser and 4Runner models may be equipped with an additional heating unit to heat the rear of the vehicle. These small units contain an additional heater core, fan and blower motor. Coolant hoses or pipes run to either the underdash heater or the engine piping under the hood. The Land Cruiser unit is located under the right front seat; the 4Runner unit is located at the rear of the center console.

REMOVAL AND INSTALLATION

Land Cruiser

1. Set the temperature control valve to COOL.
2. Remove the right front seat.
3. Disconnect the hoses running to the auxiliary heater. Have a pan and rags handy to contain drainage from the core and hoses.
4. Disconnect the wiring harness running to the unit.
5. Remove the retaining bolts holding the unit to the vehicle; remove the heater unit. Place the unit on the workbench.
6. Remove the clips and screws holding the case halves. Separate the case.
7. Remove the core from the case. The blower motor and fan may be removed if desired.

To install:

8. Place the core into the case, making certain the insulation and supports are in place. Install the blower fan if it was removed.
9. Assemble the case halves.
10. Install the unit into the vehicle. Make certain the inlet and outlet pipes are correctly placed in the grommets. Tighten the retaining screws.
11. Connect the wiring harness.

12. Install the hoses, using new clamps.
13. Install the right seat.
14. Set the heater temperature control to HOT. Start and run the engine for 1 or 2 minutes, but no more.
15. Stop the engine. Inspect the coolant level in the radiator and top up the coolant as necessary.
16. Restart the engine and warm it fully; operate the auxiliary heater and check its function. Inspect the hose joints for leaks.
17. Check the coolant level in the overflow reservoir and top up as necessary. Do NOT remove the radiator cap on a hot engine.

4Runner

1. Set the heater temperature control to COOL.
2. Remove the rear center console. Be careful lifting it away from its mountings; disconnect the wiring harness from the rear controls as soon as access is gained.
3. Disconnect the hoses from the auxiliary heater unit.
4. Remove the retaining hardware holding the heater unit and remove the unit.
5. Separate the case halves and remove the heater core. Remove the blower fan and motor if desired.

To install:

6. Assemble the heater core and blower motor into the case.
7. Connect the case halves.
8. Install the heater unit and install the retaining hardware.
9. Use new clamps and connect the heater hoses.
10. Install the console, connecting the wiring harness before the console is in its final position.
11. Set the heater temperature control to HOT. Start and run the engine for 1 or 2 minutes, but no more.

12. Stop the engine. Inspect the coolant level in the radiator and top up the coolant as necessary.

13. Restart the engine and warm it fully; operate the auxiliary heater and check its function. Inspect the hose joints for leaks.

14. Check the coolant level in the overflow reservoir and top up as necessary. Do NOT remove the radiator cap on a hot engine.

AUDIO SYSTEMS

Never operate the radio without a speaker; severe damage to the output transistors will result. If the speaker must be replaced, use a speaker of the correct impedance (ohms) or the output transistors will be damaged and require replacement.

ANTI-THEFT SYSTEMS

Some audio systems have an anti-theft system built into them. The system requires the operator to select and program a 3-digit code into the unit. (If no code is installed, the anti-theft system is inoperative; the audio unit functions as a normal unit, even after power is restored after disconnection.) Complete instructions for installing the code are found in the owner's manual for the vehicle. As long as power remains connected to the unit, it may be used in the normal fashion. Once power is disconnected from the unit, the audio unit will not function until the correct code is re-entered. This will render the unit useless if stolen; there is no way to retrieve the stored code.

The anti-theft code may be canceled or changed following an exact procedure explained in the vehicle's owner's manual. If an error is made during the procedure, the designation ERR appears in the digital window. Once 10 errors have occurred, the word HELP appears and the system will not work regardless of codes or power. If the HELP message appears, the unit must be taken to a Toyota dealer to be reset.

All of the units equipped with this system have the words ANTI THEFT SYSTEM visible on the front of the unit, usually on the tape player door. Care must be taken when working on these vehicles anytime the battery cable must be disconnected or if fuses are removed during other test procedures. If it's your vehicle, chances are good that you know the code (if one was installed); if it's a friend's vehicle, you could be in trouble. Always check with the owner before beginning any work which could interrupt power to the audio unit.

REMOVAL AND INSTALLATION

Truck and 4Runner

1. If audio unit carries the designation ANTI THEFT SYSTEM, make certain you or the vehicle owner knows the security code. If the code is not re-entered after installation, the unit will not operate.

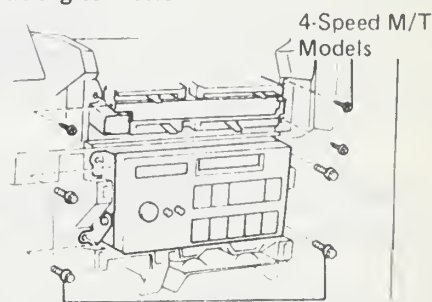
2. Remove the heater control assembly, following procedures given in this Section.

3. Remove the bolts holding the audio unit to the dash. Pull the unit out of the lower dash enough to allow access to the rear and sides.

4. Disconnect the antenna cable and wiring connectors. Remove the radio with its bracket.

To install:

5. Fit the audio unit and bracket loosely in place; connect the antenna and wiring connectors.



Models Ex. 4 Speed M/T
Truck and 4Runner audio unit

6. Work the unit gently into position. Be careful not to pinch any wires or lines under or around the unit. Install the retaining screws.

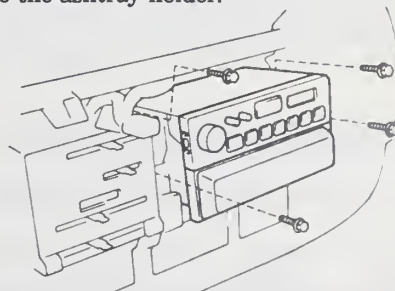
7. Install the heater control assembly.

8. Connect the negative battery cable.

9. Turn the ignition switch to ACC or ON; turn the radio ON and enter the security code if one is required. Check the system for correct operation.

Land Cruiser

1. Disconnect the negative battery cable. Remove the ashtray. Remove the ashtray holder.



Removing the Land Cruiser audio unit is straightforward once the dashboard trim panel is removed

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2. Remove the 3 screws holding the lower instrument panel trim. The trim panel is also held by six clips; each must be gently pried loose.

WARNING: The trim panel is long and thin; it is easily broken by rough handling.

3. Once the panel is loose, disconnect the wiring connectors to the switches and remove the panel from the area.

4. Remove the screws holding the audio unit to the dash.

5. Pull the unit outward enough to allow access to the sides and back. Disconnect the antenna cable and the electrical connectors. Remove the radio.

To install:

6. Loosely fit the unit into place and connect the antenna and electrical connections.

7. Fit the unit into the dash and install the retaining screws.

8. Hold the large dash panel in place and connect the wiring connectors to each switch.

9. Install the trim by aligning all the clips at once and gently pushing each into place. Install the retaining screws.

10. Install the ashtray holder and ashtray.

11. Connect the negative battery cable.

10. Turn the ignition switch to ACC or ON; turn the radio ON and enter the security code if one is required. Check the system for correct operation.

WINDSHIELD WIPERS

Blade and Arm

REMOVAL AND INSTALLATION

NOTE: Wiper blade element replacement is covered in Section 1.

1. To remove the wiper blades, lift up on the spring release tab on the wiper blade-to-wiper arm connector.

2. Pull the blade assembly off the wiper arm.

3. Press the old wiper blade insert down, away from the blade assembly, to free it from the retaining clips on the blade ends. Slide the insert out of the blade. Slide the new insert into the blade assembly and bend the insert upward slightly to engage the retaining clips.

4. To replace a wiper arm, unscrew the acorn nut which secures it to the pivot and carefully pull the arm upward and off the pivot. Install the arm by reversing this procedure. Make certain the wiper arm is reinstalled in the correct position; if not correctly aligned, the blade will slap the bodywork at the top or bottom of its stroke.

CHILTON TIP: If one wiper arm does not move when turned on or only moves a little bit, check the retaining nut at the bottom of the arm. The extra effort of moving snow or wet leaves off the glass can cause the nut to come loose—the pivot will move without moving the arm.

Windshield Wiper Motor

REMOVAL AND INSTALLATION

1. Disconnect the wiring from the wiper motor and unbolt it from the fire wall.

2. Gently pry the wiper link from the crank arm. It's a ball and socket arrangement, but may be tight.

3. Remove the motor.

4. Install the motor.

5. Connect the wiper arm linkage. The socket must be exactly aligned with the ball before snapping them together.

6. Connect the electrical lead.

Wiper Linkage

REMOVAL AND INSTALLATION

Truck and 4Runner

1. Remove the wiper motor.

2. Remove the wiper arms by removing their retaining nuts and working them off their shafts.

3. Remove the nuts and spacers holding the wiper shafts and push the shafts down into the body cavity. Pull the linkage out of the cavity through the wiper motor hole.

4. Insert the wiper linkage through the hole and install the nuts and spacers.

5. Press the wiper arm onto their shafts and install the retaining nuts.

6. Install the wiper motor.

Land Cruiser

1. Remove the wiper arm assemblies.

2. Remove the end plate from the pivot housing.

3. Remove the wiper motor complete with the linkage cable.

4. Separate the wiper motor and transmission.

5. Remove the linkage cable.

6. Install the linkage cable and connect the wiper motor to the transmission.

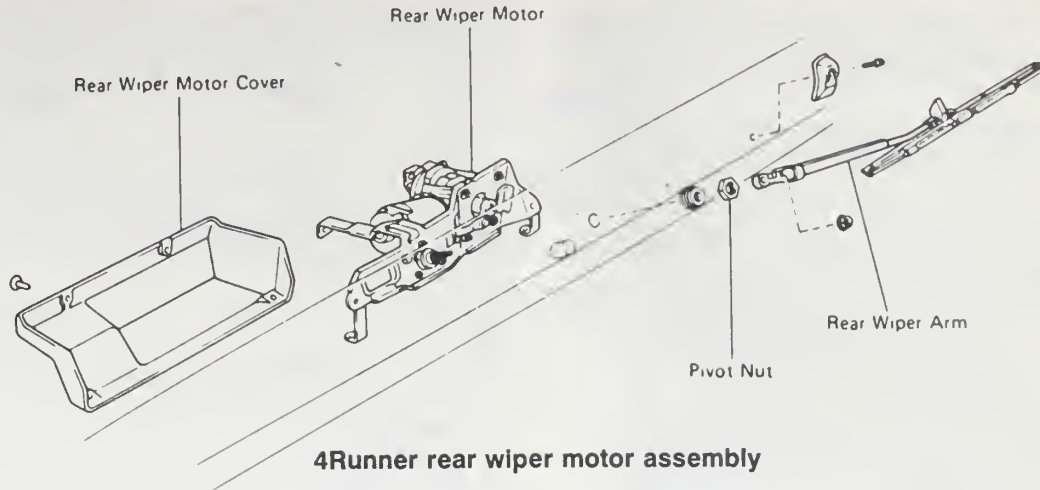
7. Install the motor with the linkage attached, install the end plate into the pivot housing and press on the wiper arms.

Rear Wiper

REMOVAL AND INSTALLATION

4Runner

1. Make certain the ignition switch is OFF.



2. Pop up the acorn nut cover, remove the nut and pull off the rear wiper.
3. Remove the pivot nut.
4. Inside, above the tailgate, pop out the 4 clips and remove the wiper motor cover.
5. Disconnect the electrical lead and the washer hose, remove the 3 mounting bolts and lift out the wiper motor.
6. Position the wiper motor and install the mounting bolts.
7. Connect the lead and the washer hose.
8. Position the wiper motor cover over the opening and press in the retaining clips.
9. Install the pivot nut and tighten it to 8 ft. lbs. (11 Nm).
10. Install the wiper arm and tighten the acorn nut to 48 inch lbs. Snap the cover down.

Land Cruiser

1. Insure the ignition switch is OFF.
2. Lift the cover at the base of the rear wiper arm, remove the retaining nut and remove the wiper arm.
3. Remove the large nut on the wiper motor axle (the part that the arm bolts to).
4. Remove the trim panel from the inside of the door.
5. Disconnect the wiper motor wire harness.
6. Remove the retaining bolts holding the motor and remove the motor. Don't bend or damage nearby linkages or components.
7. Reassemble in reverse order.

INSTRUMENTS AND SWITCHES

Instrument Cluster and Instrument Panel (Dashboard)

REMOVAL AND INSTALLATION

To keep our terms straight, we'll use Toyota's names for various dash components. The instrument panel is what you may call the dashboard; it runs completely across the front of the vehicle. The instrument panel is covered with a soft vinyl surface called the safety pad. The safety pad is the part you see; the instrument panel is the framework under it. All the instruments and warning lamps in front of the driver are contained in the combination meter, sometimes called the gauge set or instrument cluster. The combination meter is removed as a unit.

Generally, numbered components use a numbering system with item 1 on the left side of the vehicle. Knowing how many

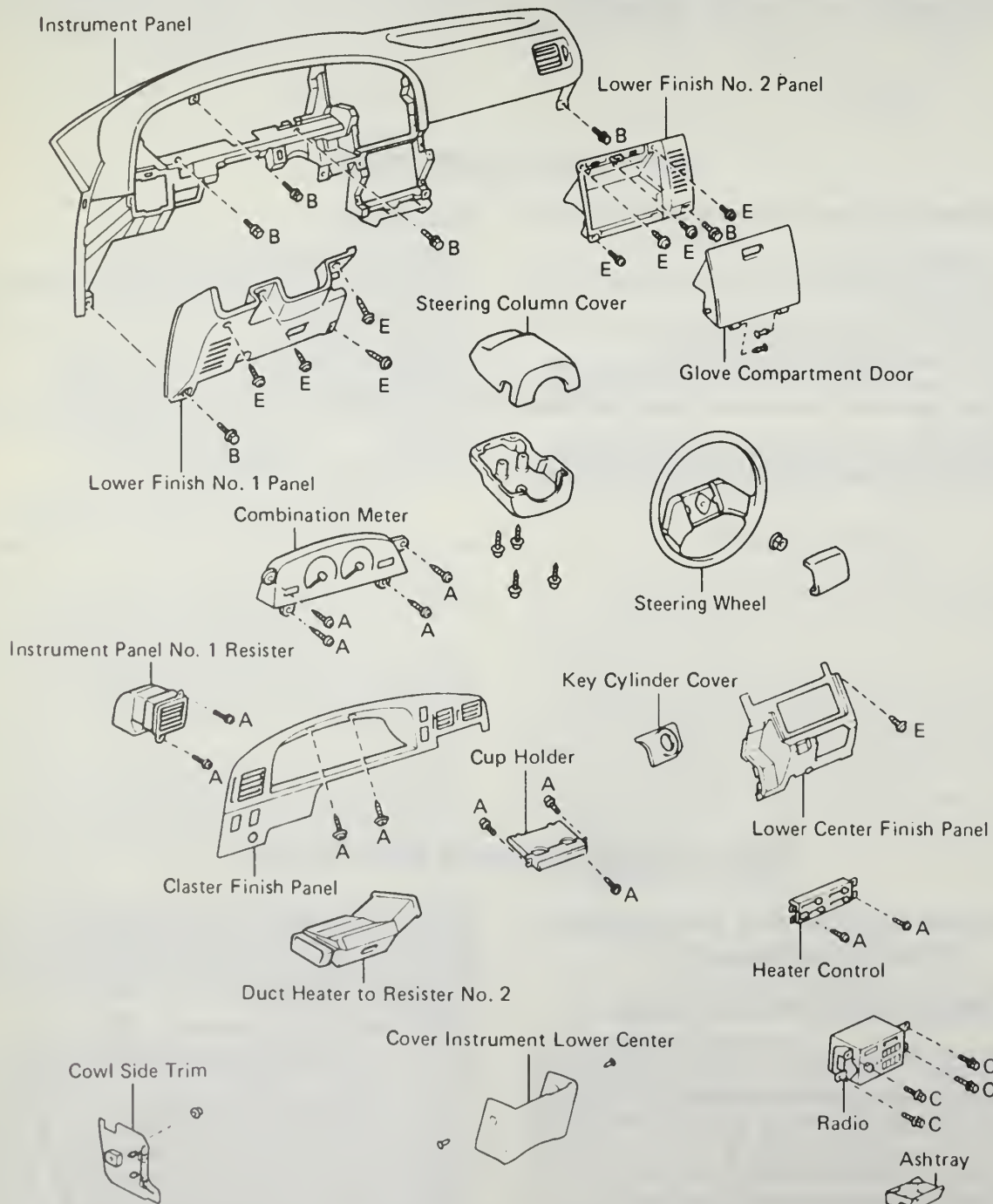
numbered components there are can be helpful, too. For example, if heater ducts Nos. 1, 2 and 3, must be removed, it's a fair bet that No. 2 is in the center. If the procedure only refers to Nos. 1 and 2, one may be on the left side and 2 on the right of the passenger compartment.

When disassembling components, always suspect the hidden screw or clip. Much of the fit and finish in the interior is accomplished by using concealed retainers to keep panels in place. Don't force anything during removal; if any resistance is felt, search out the hidden connector. Some of the panels assemble only in the correct order; pay attention. Take note of which bolts and screws go into each retainer; a too-long bolt can damage wiring or components behind the assembly being held.

Finally, understand that this is a lengthy project. Work slowly and carefully so as not to damage anything. Label or mark each electrical connector as it is disconnected; many of the plastic connector shells can be marked with an indelible laundry pen or

6 CHASSIS ELECTRICAL

Code	Shape	Size	Code	Shape	Size	Code	Shape	Size
A		$\phi = 5$ (0.20) L = 14 (0.55)	B		$\phi = 6$ (0.24) L = 22 (0.87)	C		$\phi = 5$ (0.20) L = 18 (0.71)
D		$\phi = 5$ (0.20) L = 16 (0.63)	E		$\phi = 5$ (0.20) L = 16 (0.63)			



Truck Instrument panel components. Use the hardware chart to aid installation

similar marker. As a panel or component is removed, disconnect the wiring running to switches or components held by the panel. Be careful working around wires and harnesses; most are held by retainers and do not allow a lot of slack.

Truck and 4Runner

1. Disconnect the negative battery cable.
2. Remove the steering wheel.
3. Remove the upper and lower steering column covers.
4. Remove the hood release lever from the panel. It's held by two screws.
5. Remove the cowl side trim on each side. You might refer to it as the kick panel.
6. Remove the lower center instrument panel cover.
7. Remove the ignition key cylinder cover.
8. Remove the No. 1 lower finish panel; this is the panel holding the left speaker and running under the steering column.
9. Remove the heater duct to No. 2 outlet.
10. Pull off the heater control knobs, remove the A/C switch if equipped and gently pry up on the heater control unit to remove it. The prying tool should have a taped or protected edge.

11. For all models except Trucks with 4 speed manual transmissions, remove the 3 screws holding the meter trim. Pull the trim or surround panel outward and disconnect the connectors. On 4Runner, remove the two screws and the cup holder from the panel.

12. For Trucks with 4 speed manual transmissions, the trim is held only by two screws. Disconnect the connectors and remove the trim panel.

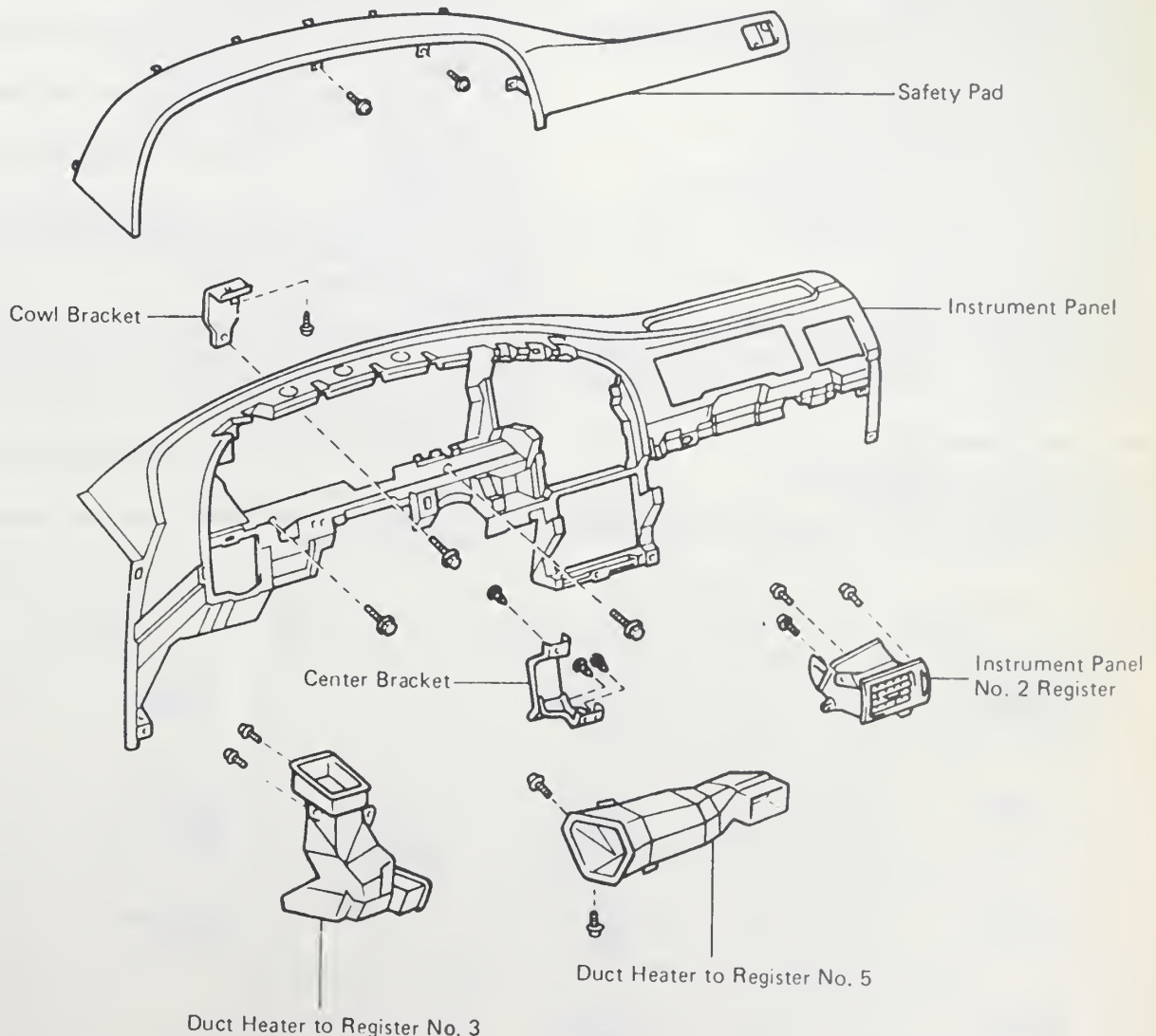
13. Remove the No.1 air outlet. It's held by 2 screws.

14. Remove the four screws holding the combination meter. Work it out of the panel until access is gained to the rear. Disconnect the speedometer cable and remove the electrical connectors. Remove the meter assembly, placing it in a safe location out of the work area. If this is as far as you planned to go, pick up the installation procedure at Step 26.

15. Remove the No.2 lower trim panel with the glove box door attached. The panel is held by 4 screws and 1 bolt.

16. Remove one bolt holding the lower center finish panel (around the radio and heater controls) and remove the panel.

17. Remove the heater control assembly. Don't forget to disconnect each control cable at the heater box. Withdraw the cables through the dash with the controller.



Truck and 4Runner instrument panel and safety pad

6 CHASSIS ELECTRICAL

18. Remove the audio unit.

19. Remove the bolts holding the instrument panel and remove the entire panel assembly. Because of the nature of the rear clips, lift the panel upward at an angle. It will come loose with various items still attached; disconnect the wiring connectors as soon as easily reached. An assistant is useful due the awkward size and location of the panel.

20. Once removed from the vehicle, the safety pad, heater ducts and assorted brackets may be removed if desired.

To install:

21. Assemble the instrument panel, safety pad and other items removed. Fit the panel into place, connect the wiring and secure the retaining bolts. Make certain the panel is flush and level. The heater vent ducts must match up exactly with no leaks. Make any needed adjustments now.

22. Install the radio.

23. Install the heater controls.

24. Install the lower center finish panel. Don't forget the screw.

25. Install the No.2 lower trim panel with the glove box door.

26. Place the combination meter loosely in place and connect the speedometer cable and wiring harnesses. Fit the meter into place and install the retaining screws.

27. Install the left air outlet.

28. Install the meter hood and finish panel. Install the screws and make certain all the vents and ductwork align. Check that each wiring connector is correctly placed.

29. Install the heater control trim plate.

30. Connect the air duct to air outlet No. 2.

31. Install the No. 1 lower finish panel.

32. Install the ignition key cylinder cover.

33. Install the lower center instrument panel cover.

34. Install the cowl side trim (kick panels).

35. Install the hood release and bracket.

36. Install the steering column covers.

37. Install the steering wheel.

38. Connect the negative battery cable.

39. Start the engine, allowing it to idle. Check the function of each dash component including all switches, heater and A/C output, speaker operation and dashboard warning lamps and instruments.

1989-90 Land Cruiser

1. Disconnect the negative battery cable.

2. Remove the steering wheel.

3. Remove the Nos. 2 and 3 air ducts. These are above the driver's knees under the dash.

4. Disconnect the throttle cable from the accelerator pedal and retainer. Remove the cable set nut and remove the cable.

5. Remove the hood release lever and the fuel lid opener lever.

6. Remove the heater control lever knobs. Remove the ash tray.

7. Remove the five screws and two clips holding the center instrument finish panel. Remove the panel and disconnect the wiring harnesses.

8. Remove the seven screws holding the instrument cluster trim panel. Loosen the panel, disconnect the wiring and unhook the speedometer cable.

9. Remove the audio unit.

10. Remove the glove box door. Remove the courtesy switch and light.

11. Remove the four screws holding the glove box; remove the latch striker and remove the glove box.

12. Remove the mounting bolt holding the EFI computer; pull it out gently and disconnect the wire harness. Place the computer in a very safe location out of the work area.

13. Remove air ducts Nos. 1, 3 and 4; each is held by a single screw.

14. At the side defrosters, remove only the lower screw and disconnect the defroster hose.

15. Remove the four screws and four nuts holding the safety pad. Loosen two clips and remove the pad.

16. Remove the heater control panel.

17. Disconnect the electrical connectors at the mirror control switch, the dimmer and 4WD control.

18. Remove the fuse box; it's held by two screws.

19. Remove the two upper side mounting bolts holding the steering column.

20. The instrument panel is held by 15 bolts. Once the bolts are removed, move the panel towards the rear of the vehicle to remove it. Once removed, the various components still on the panel may be removed if desired.

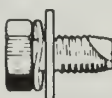
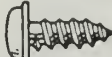
To install:

21. Assemble the instrument panel with any items removed. Fit the panel into place, connect the wiring and secure the retaining bolts. Make certain the panel is flush and level. The heater vent ducts must match up exactly with no leaks. Make any needed adjustments now.

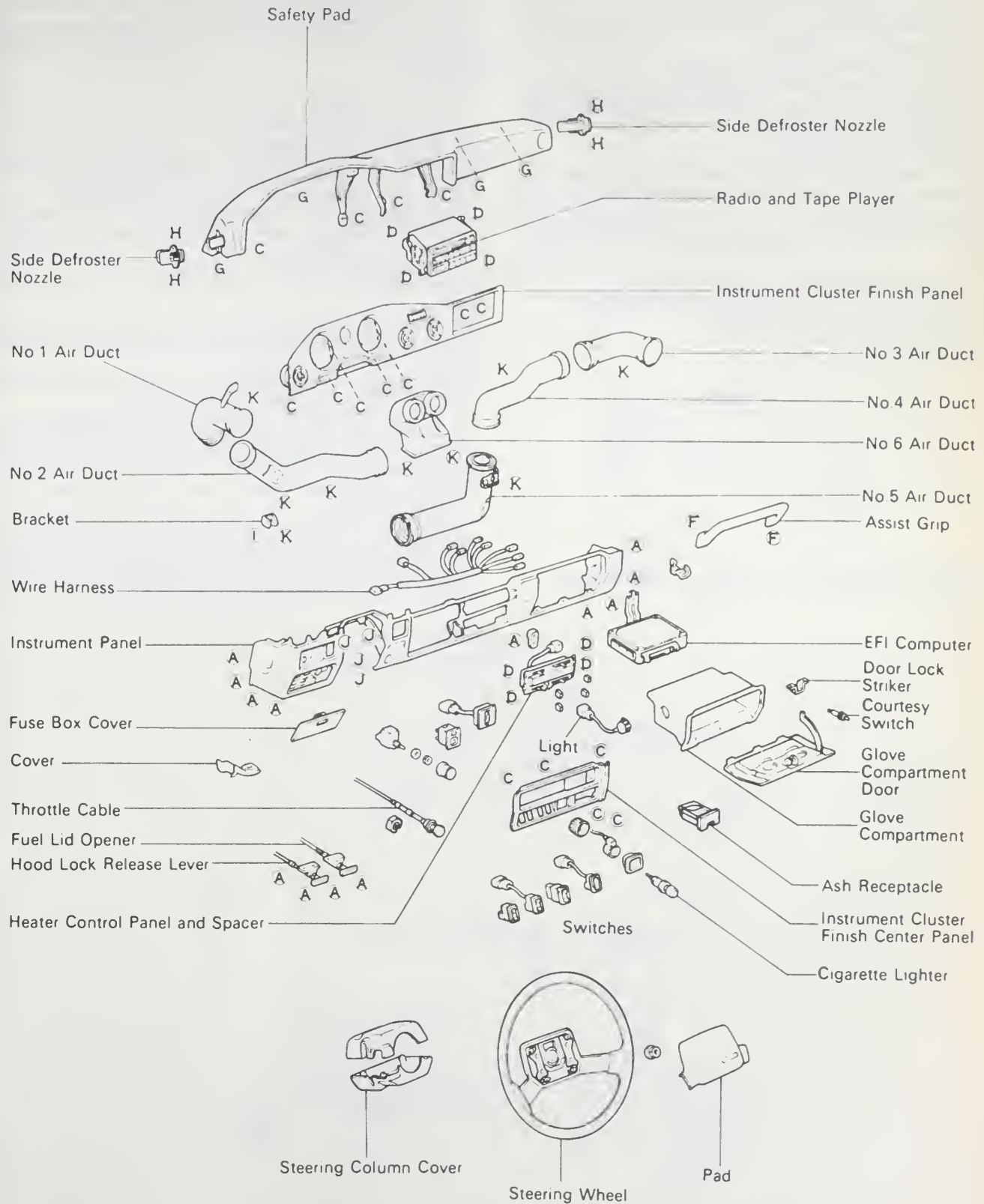
22. Install the upper side mounting bolts holding the steering column.

23. Install the fuse box and cover.

24. Connect the mirror control switch, the dimmer and the 4WD switch connectors.

Code	Shape		Code	Shape		Code	Shape	
A		$\phi = 6$ L = 16	E		$\phi = 5$ L = 16	I		$\phi = 6$ L = 16
B		$\phi = 5$ L = 16	F		$\phi = 8$	J		$\phi = 8$ L = 16
C		$\phi = 5$ L = 16	G		$\phi = 6$	K		$\phi = 5$ L = 12
D		$\phi = 5$ L = 25	H		$\phi = 5$ L = 20	-	-	-

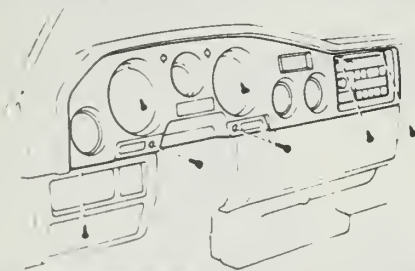
Hardware key for 1989-90 Land Cruiser dashboard



1989-90 Land Cruiser dashboard components. Letters refer to hardware key

6 CHASSIS ELECTRICAL

25. Connect the cables and install the heater controls.
26. Install the safety pad, making sure the clips are properly seated and that the piece aligns perfectly.
27. Connect the side defroster hoses to the grilles and install the lower screws.
28. Connect the Nos. 1,3, and 4 air ducts.
29. Connect the harness to the EFI computer and install the unit. Make sure the harness is connected squarely and firmly.
30. Install the glove box and striker. Connect the switch and light and install the glove box door.
31. Install the audio unit.
32. Place the instrument finish panel in place. Connect the speedometer cable and the electrical harnesses. Install the panel and the retaining screws.
33. Install the center lower trim panel, connecting the wiring as needed. Install the ash tray and install the heater control knobs.
34. Install the hood release and fuel door levers.
35. Connect the throttle cable to the accelerator pedal.
36. Install the Nos. 2 and 3 air ducts.
37. Install the steering column covers.
38. Install the steering wheel.

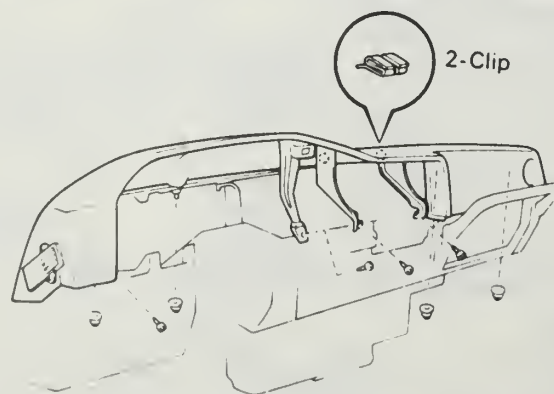


Removing instruments and trim — 1989-90 Land Cruiser

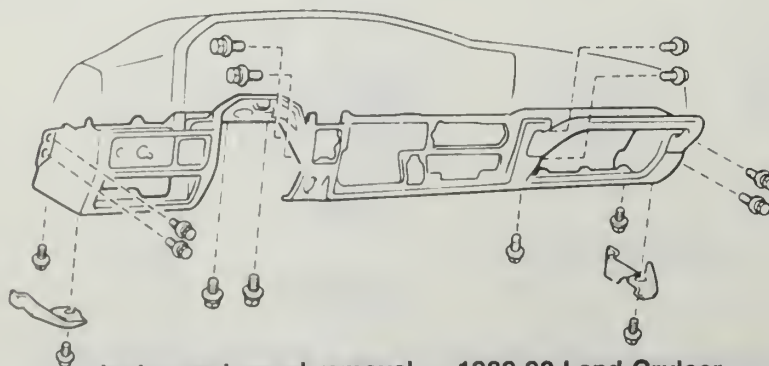
39. Connect the negative battery cable.
40. Start the engine, allowing it to idle. Check the function of each dash component including all switches, heater and A/C output, speaker operation and dashboard warning lamps and instruments.

1991 Land Cruiser

1. Disconnect the negative battery cable.
2. Remove the steering wheel.
3. Apply strips of protective tape on the inside of each windshield pillar. This will protect the trim during removal.
4. Remove the upper and lower steering column covers.
5. Remove the hood release and fuel door release levers.
6. Remove the four screws holding the lower trim panel below the steering column.
7. Remove the heater duct running to the left dash outlet (No. 2). The duct is the one under the dash, above the driver's knees.
8. Remove the combination switch from the steering column. (Combination switch is the lighting control/turn signal/wiper control assembly.)
9. Remove the turn signal bracket from the steering column; it's the piece just below the combination switch.
10. Remove the ashtray and remove the ashtray holder.
11. Remove the three screws holding the lower instrument panel trim. The trim panel is held by six clips which must be released to remove the panel.
12. Remove the instrument cluster trim; it is held by six screws and two clips.
13. Remove the four screws holding the combination meter and gently loosen it; disconnect the electrical harnesses and unhook the speedometer cable. Place the instrument cluster in a safe location out of the work area. If this is as far as you planned to go, pick up the installation procedure at Step 28.



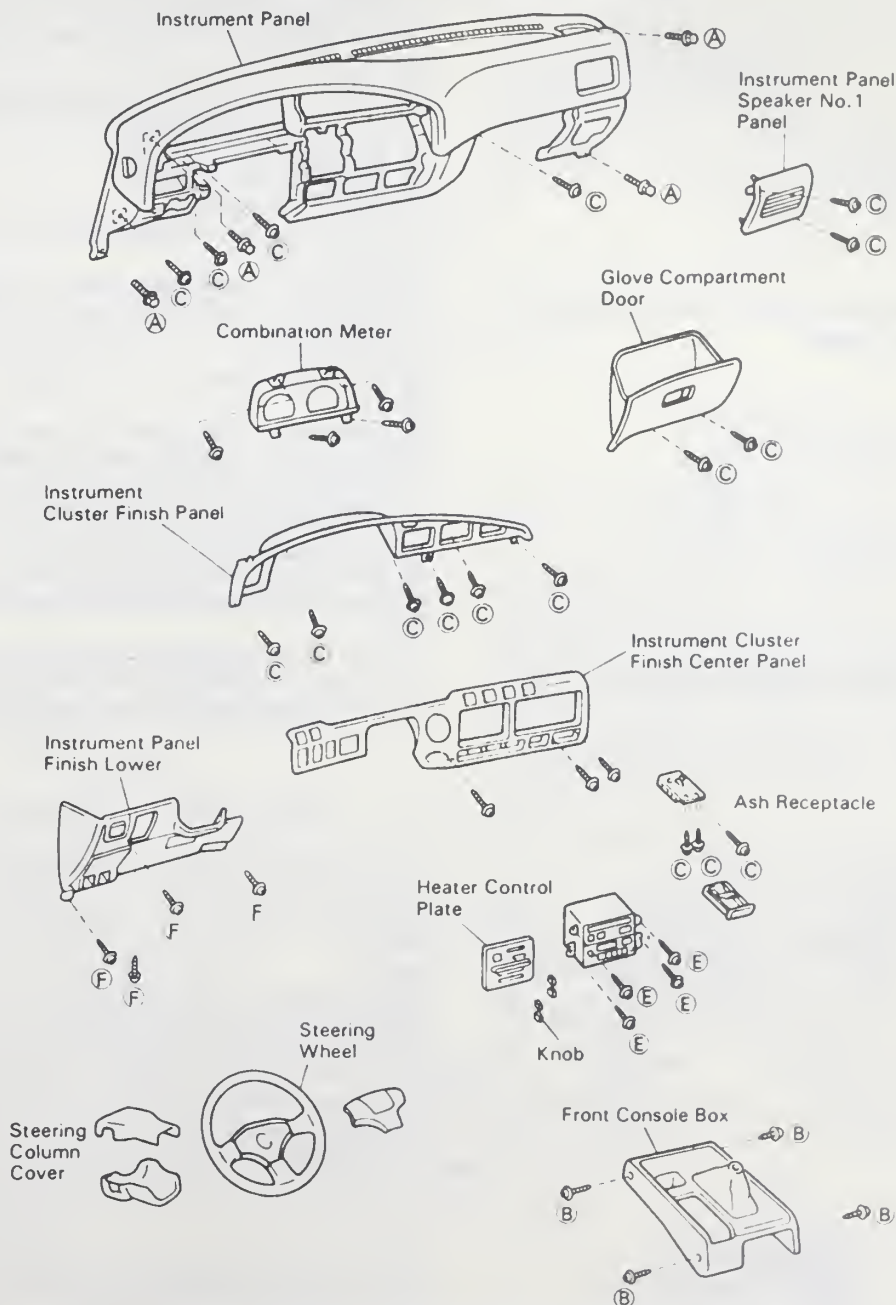
Safety pad — 1989-90 Land Cruiser



Instrument panel removal — 1989-90 Land Cruiser

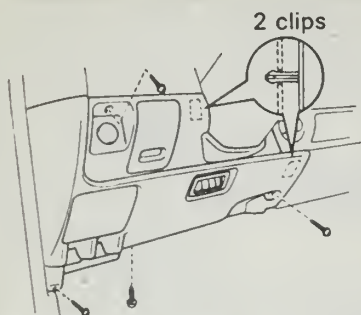
Code	Shape	Size	Code	Shape	Size	Code	Shape	Size
(A)		$\phi = 6$ (0.24) L = 25 (0.98)	(B)		$\phi = 5$ (0.20) L = 25 (0.98)	(C)		$\phi = 5.22$ (0.2055) L = 14 (0.55)
(D)		$\phi = 8$ (0.31) L = 30 (1.18)	(E)		$\phi = 5$ (0.20) L = 16 (0.62)	(F)		$\phi = 5.22$ (0.2055) L = 18 (0.71)

Hardware key – 1991 Land Cruiser

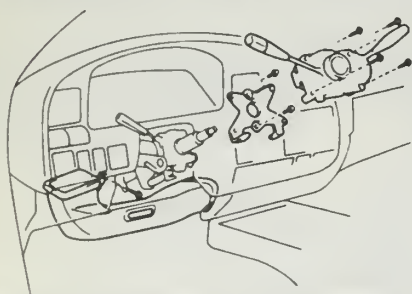


1991 Land Cruiser Instrument panel components

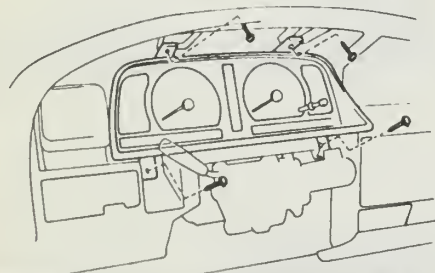
6 CHASSIS ELECTRICAL



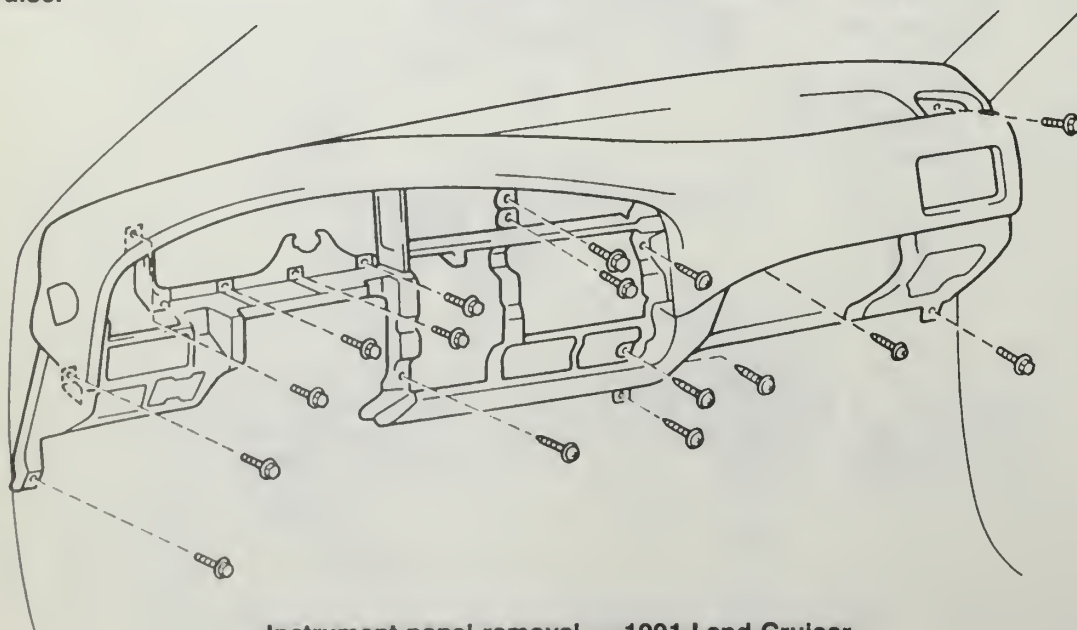
Removing the lower trim panel – 1991 Land Cruiser



Removing the combination switch and turn signal plate – 1991 Land Cruiser

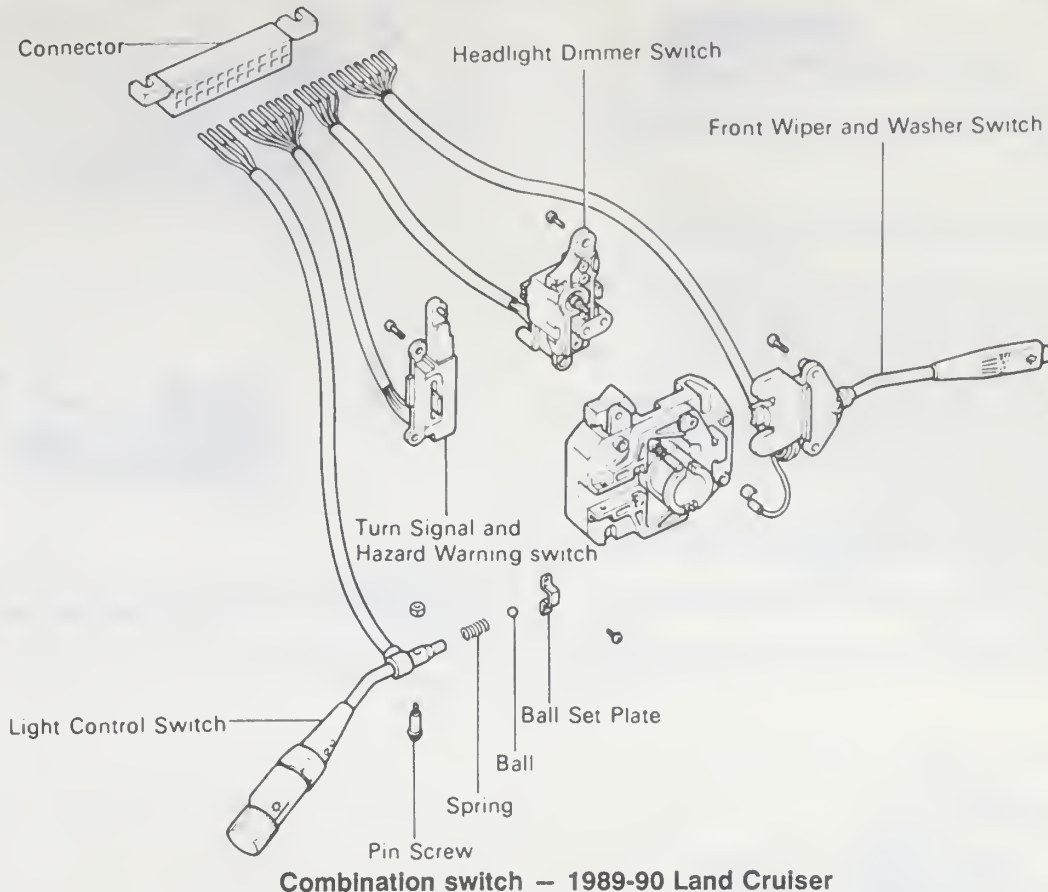


Four screws hold the combination meter – 1991 Land Cruiser



Instrument panel removal – 1991 Land Cruiser

14. Remove the heater control unit.
15. Remove the audio unit.
16. Remove the front (shifter) console.
17. Remove the dash mounted speaker covers. Remove and disconnect the speakers.
18. Remove the glove compartment door.
19. Remove the screws holding the engine ECU; gently remove it and disconnect the wire harness. Place the ECU in a protected location out of the work area.
20. The instrument panel is held by 10 bolts and six screws. Remove them and remove the panel. Once removed, the safety pad, air vents, etc. may be removed if desired.
- To install:**
21. Assemble the instrument panel with any items removed. Fit the panel into place and secure the retaining bolts. Make certain the panel is flush and level. The heater vent ducts must match up exactly with no leaks. Make any needed adjustments now.
22. Connect the wire harness to the engine ECU. Install the ECU in the right side of the instrument panel.
23. Install the glove box door.
24. Install the speakers and the speaker covers.
25. Install the front console.
26. Install the audio unit.
27. Install the heater control unit. Don't forget the knobs on the levers.
28. Place the combination meter in position. Connect the speedometer cable and attach the wiring connectors. Make sure the electrical connectors are squarely and firmly seated. Install the meter unit.
29. Install the cluster trim panel. Make sure the clips are in place.
30. Install the lower center trim panel. All six clips must be correctly seated. Install the retaining screws.
31. Install the ashtray holder and the ashtray.
32. Install the turn signal bracket and the combination switch.
33. Connect the heater duct to air outlet No. 2.
34. Install the lower trim panel and the 4 screws.
35. Attach the hood and fuel door levers.
36. Install the steering column covers. Install the steering wheel.
37. Remove the protective tape from the windshield pillars.
38. Connect the negative battery cable.
39. Start the engine, allowing it to idle. Check the function of



each dash component including all switches, heater and A/C output, speaker operation and dashboard warning lamps and instruments.

Combination Switch (Lighting/Wipers/Turn Signal Switches)

REMOVAL AND INSTALLATION

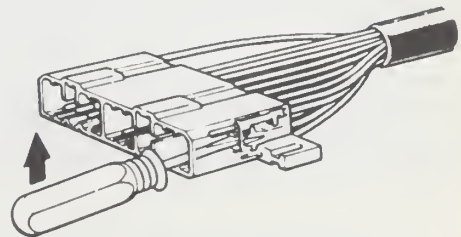
The individual switches within the combination switch are individually replaceable after the combination assembly is removed and disassembled. It is not difficult but is exacting, requiring careful removal of wire terminals from the multi-pin connector.

1. Insure the ignition is switched OFF.
2. Remove the steering wheel pad and remove the steering wheel. Use of a steering wheel puller is strongly recommended. Always scribe matchmarks on the wheel hub and the steering column so the wheel can be reinstalled straight.
3. Remove the upper and lower steering covers. Remove the retaining screws holding the combination switch to the column.
4. Trace the wire harness down the column and disconnect the connector. Release the harness from the harness clamp(s).
5. Remove the combination switch from the column and place it on the workbench.
6. Identify the component to be replaced. Identify each wire color running from the switch (to be replaced) to the connector. These wires (only) will need to be removed so the new ones can be installed.
7. On all but 89-90 Land Cruiser, the cover on the back of the

connector must be raised to allow the wire terminal to be removed.

8. Diagram each wire and terminal to be removed. The new wiring must be installed exactly as original. From the front or plug end, insert a small pick or probe between the locking lug and the wire terminal. Pry down the locking lug with the tool and pull the terminal out from the rear. Repeat the procedure for each wire from the switch to be replaced.

9. With the wires free, remove the retaining screws holding the switch to be changed and remove it. The lighting control



Removing switch terminals from multi-connector

6 CHASSIS ELECTRICAL



Push the new terminal into the connector until it is locked in place

stalk has a spring and small ball with it; don't lose them.

To install:

10. Assemble the new component(s) onto the switch. Retaining screws should be tight enough to hold but not over tight. Components with cracked plastic won't stay in place.

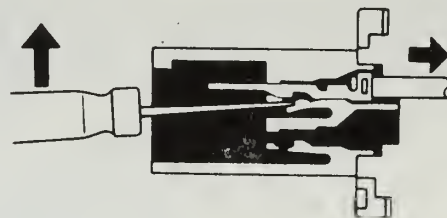
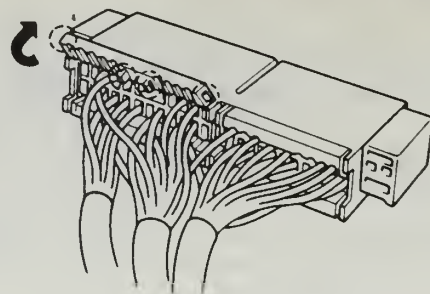
11. Track the new wires into the harness and place each wire loosely in its correct terminal socket.

12. Use the removal tool to push on the back of the terminal (NOT on the wire) and force the terminal into the connector. Each terminal must be pushed in until it overrides the locking lug. Test each one by gently pulling the wire backwards; it should be positively locked in place.

13. Fit the combination switch assembly onto the steering column and install the retaining screws. Install the upper and lower steering column covers.

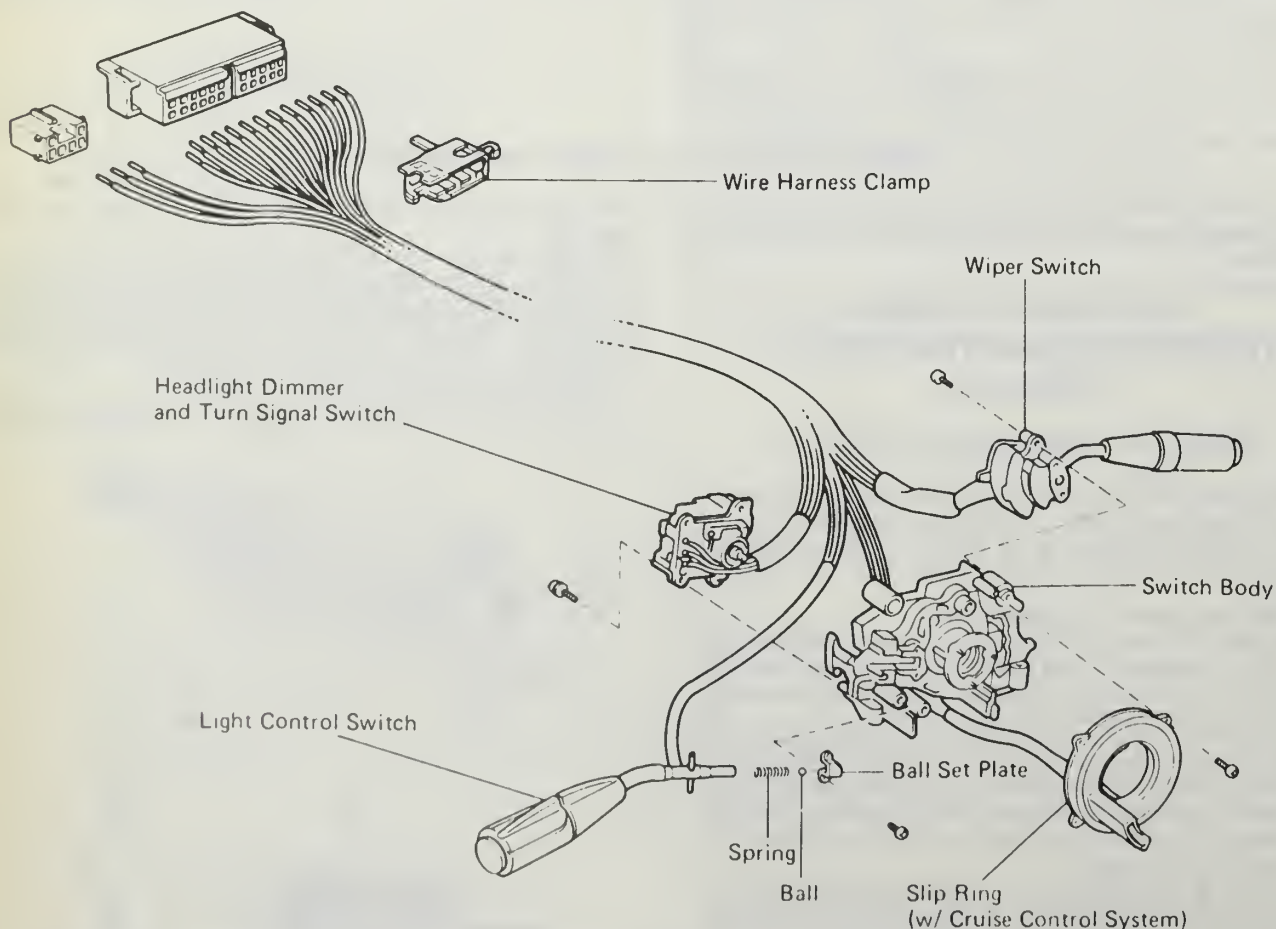
14. Install the wire harness into the clips and retainers; connect the connectors.

15. Align the matchmarks and reinstall the steering wheel and pad.

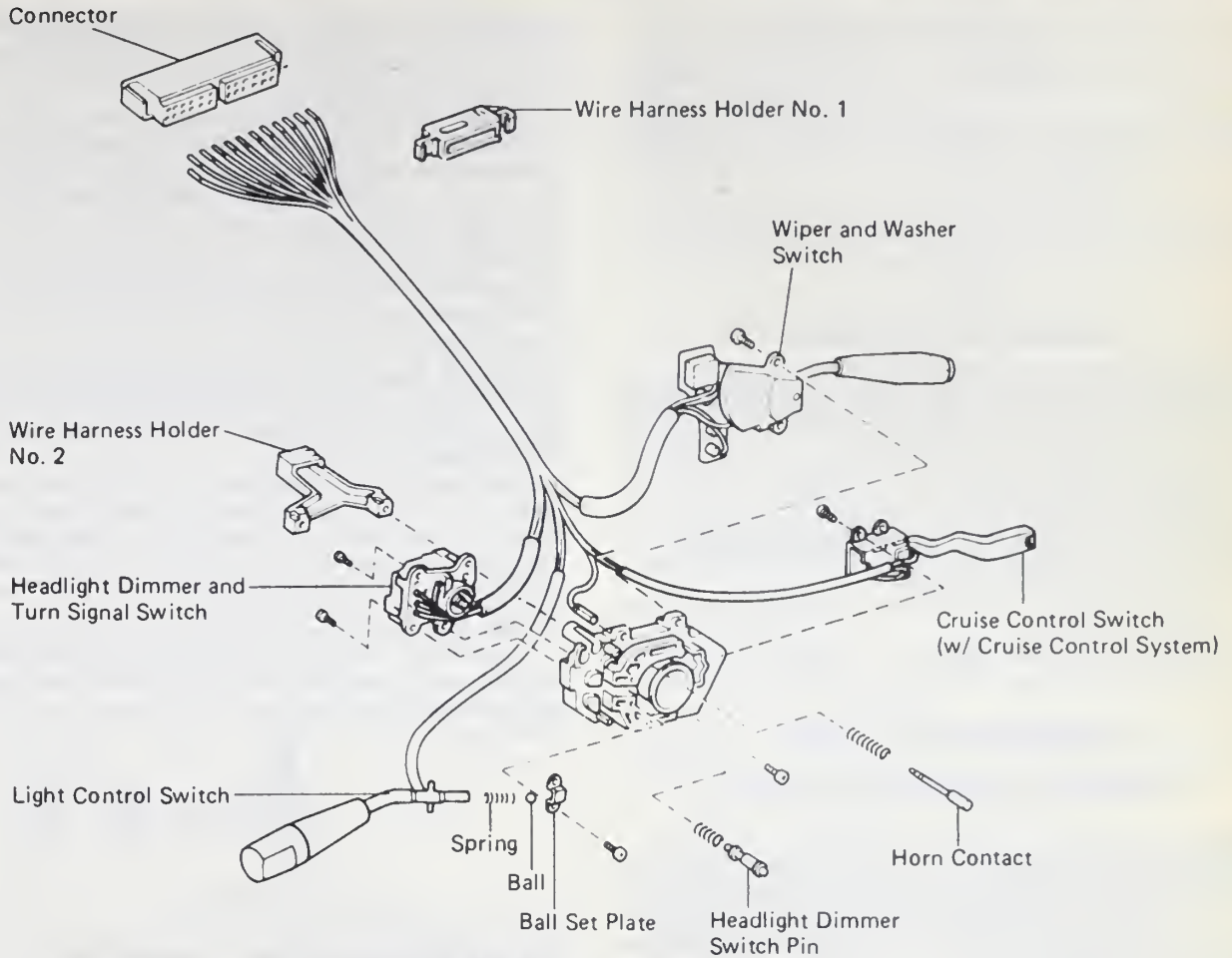


Raise the terminal cover on the back of the connector. Newer connectors use two rows terminals

16. Turn the ignition switch ON and check the function of each control item.



Combination switch – Truck and 4Runner



Combination switch — 1991 Land Cruiser

Ignition Switch

REMOVAL AND INSTALLATION

Both the electrical portion of the ignition switch and the key/lock portion may be replaced without removing the housing or bracket holding them. The bracket holding the ignition switch assembly is held to the column by bolts whose heads were intentionally broken off at installation. About the only time the bracket must be removed would be if the steering column or tube must be replaced. In the event that the bracket must be removed, the headless bolts must be centerpunched, drilled and removed with a screw extracting tool.

1. Turn the ignition OFF and remove the key from the ignition.

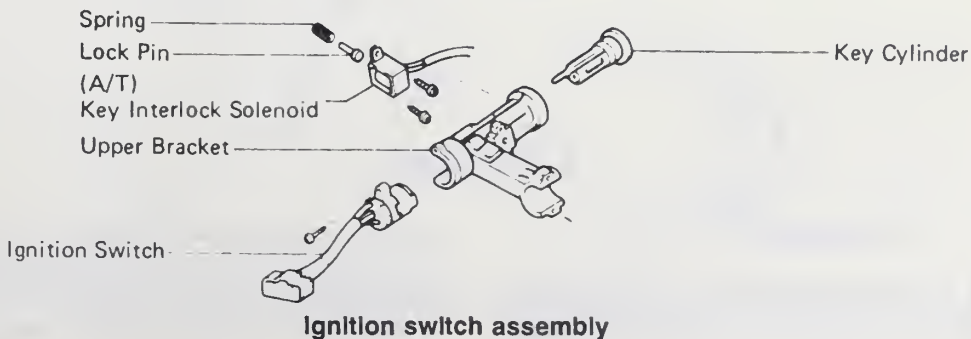
2. Remove the steering wheel pad and remove the steering wheel.

3. Remove the upper and lower steering column covers. Remove the combination switch.

4. Disconnect the ignition wiring harness connector.

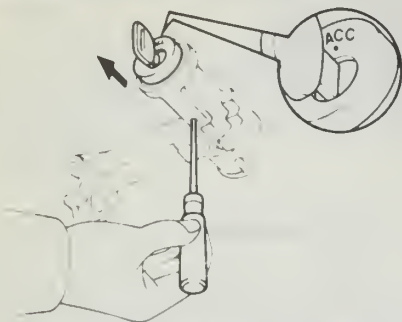
5. If only the electrical switch needs replacement, remove the retaining screw at the back of the lock housing and remove the switch. If the automatic transmission interlock relay must be changed, it may be unbolted from the housing—don't lose the spring and lock pin.

6. If the key lock assembly is to be changed, place the key in the switch and turn the key to the ACC position. Insert a thin rod in the hole at the bottom of the housing and press the stop tab inward. While holding the tab in, pull the cylinder out of the housing.



Ignition switch assembly

6 CHASSIS ELECTRICAL



Removing the lock cylinder

To install:

7. Install the new lock cylinder if necessary, making certain the key is in the ACC position before installation. Insert the cylinder and be sure the stop tab engages the hole. Once installed, turn the switch OFF and remove the key.
8. Align the electrical switch with the back of the key cylinder. Install the retaining screw.
9. Connect the wiring harness connector. Make certain the harness is correctly routed and held by its clamps and clips.
10. Install the combination switch.
11. Install the steering wheel. Install the upper and lower steering column covers.
12. Operate the ignition switch in all positions, checking for correct function and lack of binding.

Speedometer Cable

REMOVAL AND INSTALLATION

Speedometer Cable

The speedometer cable connects a rotating gear within the transmission to the dashboard speedometer/odometer assembly. The dashboard unit interprets the number of turns the made by the cable and displays the information as miles per hour and total mileage.

Assuming that the transmission contains the correct gear for the vehicle, the accuracy of the speedometer depends primarily on tire condition and tire diameter. Badly worn tires (too small in diameter) or over-inflation (too large in diameter) can affect the speedometer reading. Replacement tires of the incorrect overall diameter (such as oversize snow tires) can also affect the readings.

Generally, manufacturers state that speedometer/odometer error of plus or minus 10% is considered normal due to wear and other variables. Stated another way, if you drove the car over a measured 1 mile course and the odometer showed anything between 0.9 and 1.1 miles, the error is considered normal. If you

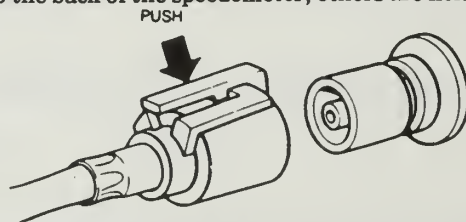
plan to do any checking, always use a measured course such as mileposts on an Interstate highway or turnpike. Never use another car for comparison—the other car's inherent error may further cloud your readings.

The speedometer cable can become dry or develop a kink within its case. As it turns, the ticking or light knocking noise it makes can easily lead an owner to chase engine related problems in error. If such a noise is heard, carefully watch the speedometer needle during the speed range in which the noise is heard. Generally, the needle will jump or deflect each time the cable binds. The needle motion may be very small and hard to notice; a helper in the back seat should look over the driver's shoulder at the speedometer while the driver concentrates on driving.

CHILTON TIP: The slightest bind in the speedometer cable can cause unpredictable behavior in the cruise control system. If the cruise control exhibits intermittent surging or loss of set speed symptoms, check the speedometer cable first.

Some cables do not attach directly to the speedometer assembly but rather to an electrical pulse generator. These pulses may be used for the meter and mileage signal. Additionally, the electric signals representing the speed of the car can be used by the fuel injection control unit, the cruise control unit and other components. To change the cable:

1. Remove the instrument cluster and disconnect the cable at the speedometer. On some models it may be possible to disconnect the cable by reaching under the dash. Some connectors screw onto the back of the speedometer; others are held by plastic clips.



The plastic retainer must be pushed down to release the speedometer cable

2. Disconnect the other end of the speedometer cable at the transmission extension housing and pull the cable from its jacket at the transmission end. If you are replacing the cable because it is broken, don't forget to remove both pieces of broken cable.
3. Lubricate the new cable with graphite speedometer cable lubricant, and feed it into the cable jacket from the lower end.
4. Connect the cable to the transmission, then to the speedometer. Note that both ends of the cable are square; the ends must fit properly in the fittings.
5. Plug the electrical connector into the instrument cluster, and replace the cluster if it was removed.

LIGHTING

Headlights

Headlights, like any other lighting device, can fail due to broken filaments. The front of any car is the worst possible location for a lighting device since it is subject to impact, extensive tem-

perature change and severe vibration—all of which shorten the life of the light. The front of the car is also where good lighting is needed the most so it's not uncommon to have to replace a headlight during the life of the vehicle.

There are two general styles of headlamps, the sealed beam

and replaceable bulb type. The sealed beam is by far the most common and includes almost all of the circular and rectangular lamps found on vehicles built through the 1980s. The sealed beam is so named because it includes the lamp (filament), the reflector and the lens in one sealed unit. Sealed beams are available in several sizes and shapes. All Toyota trucks covered in this book except the 1991 Land Cruiser use sealed beam headlights; the '91 Land Cruiser uses replaceable bulbs.

The replaceable bulb is the newer technology. Using a small halogen bulb, only the lamp is replaced, while the lens and reflector are part of the body of the car. This is generally the style found on wrap-around or "European" lighting systems. While the replaceable bulbs are more expensive than sealed beams, they generally produce more and better light. The fixed lenses and reflectors can be engineered to allow better frontal styling and better light distribution for a particular vehicle.

It is quite possible to replace a headlight of either type without affecting the alignment (aim) of the light. Sealed beams mount into a bracket (bucket) to which springs are attached. The adjusting screws control the position of the bucket which in turn aims the light. Replaceable bulbs simply fit into the back of the reflector. The lens and reflector unit are aimed by separate adjusting screws.

Take a moment before disassembly to identify the large adjusting screws (generally two for each lamp, one above and one at the side) and don't change their settings.

With the exception of the oldest vehicles, sealed beams are removed from the outside of the car. Start with the outer trim pieces and work your way in to the lamp and its retainer. Bulb type units are almost always replaced from under the hood.

REMOVAL AND INSTALLATION

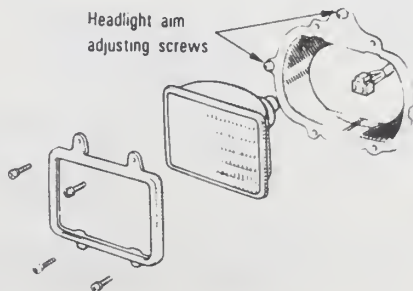
Sealed Beams

CAUTION

Most headlight retaining rings and trim bezels have very sharp edges. Wear gloves. Never pry or push on a headlamp; it can shatter suddenly.

1. Remove the headlight bezel (trim) and/or the radiator grille, as necessary.
2. The sealed beam is held in place by a retainer and either 2 or 4 small screws. Identify these screws before applying any tools.

NOTE: DO NOT confuse the small retaining screws with the larger aiming screws. There will be two aiming screws or adjusters for each lamp. (One adjuster controls the up/down motion and the other controls the left/right motion.) Identify the adjusters and avoid them during removal. If they are not disturbed, the new headlamp will be in identical aim to the old one.



3. Using a small screwdriver (preferably magnetic) and a pair of taper-nose pliers if necessary, remove the small screws in the headlamp retainer. **DON'T** drop the screws; they vanish into unknown locations.

CHILTON TIP: A good kitchen or household magnet placed on the shank of the screwdriver will provide enough grip to hold the screw during removal.

4. Remove the retainer and the headlamp may be gently pulled free from its mounts. Detach the connector from the back of the sealed beam unit and remove the unit from the car.

CAUTION

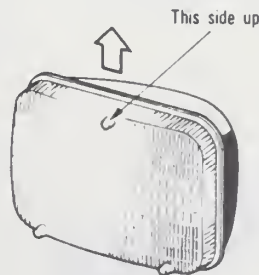
The retainers can have very sharp edges. Wear gloves.

5. Place the new headlamp in position and connect the wiring harness. Remember to install the rubber boot on the back of the new lamp—it's a water seal. Make sure the headlight is right-side up.
6. Have an assistant turn on the headlights and check the new lamp for proper function, checking both high and low beams before final assembly.
7. Install the retainer and the small screws that hold it.
8. Reinstall the headlight bezel and/or grille.

Replaceable Bulb 1991 Land Cruiser

1. With the ignition switch OFF and the headlamp switch OFF, raise and prop the hood.
2. If the right headlamp is to be changed, lift out the coolant reserve tank. Place the tank in an out of the way location but **NOT** on the battery or engine. Don't spill any coolant.
3. If the left headlamp is to be changed:
 - a. Remove the air duct (3 bolts).
 - b. Remove the air suction silencer and the air switching valve. Label the hoses so they go back in the correct places.
 - c. Remove the underhood cooling fan. It's held by 3 bolts; don't forget to disconnect the electrical harness.
4. Unplug the connector from the back of the lamp. The connector may be very tight and require wiggling to loosen; support the lamp while with your other hand while wiggling the connector loose.
5. Turn the bulb socket about 45° counter-clockwise to loosen it. Remove the bulb.
6. Install the new bulb with the socket pointing up. Make certain all three guide tabs fit into their correct slots. Turn the socket clockwise to lock it in place.

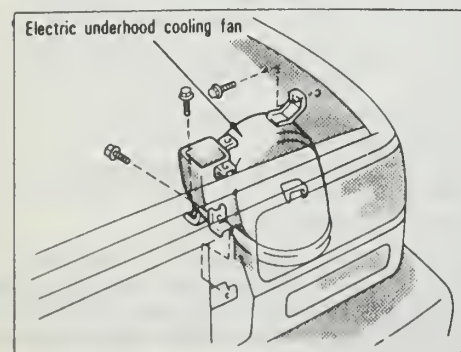
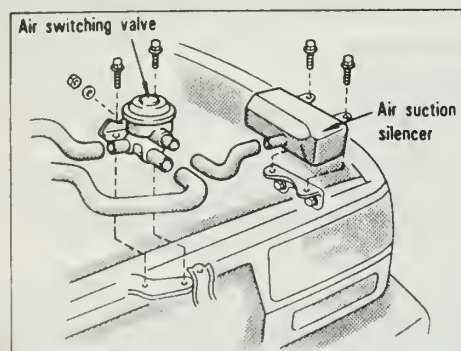
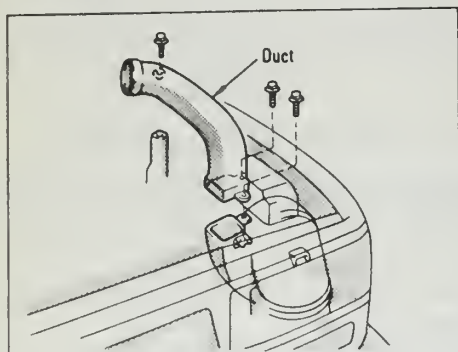
WARNING: Hold the new bulb by the base; do **NOT** touch the glass part with fingers or gloves. The grease left on the glass will form hot spots and shorten the life of the bulb. If the glass is accidentally touched, clean the glass with alcohol.



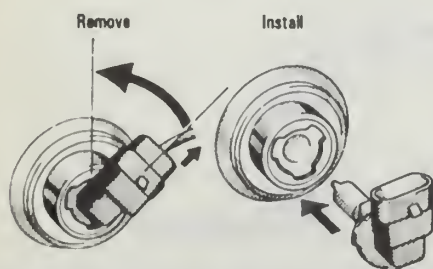
Only loosen the bezel retaining screws — leave the aiming screws untouched. The single tab denotes the top of the lamp

6 CHASSIS ELECTRICAL

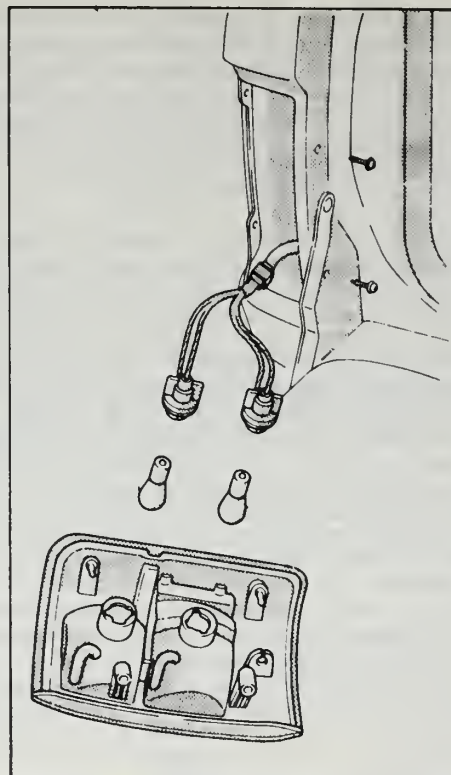
7. Connect the wiring connector firmly.
8. Turn the headlights ON and check both high and low beam function.
9. Turn the headlights OFF.
10. Reinstall the underhood fan, air switching valve, silencer, hoses and ducting (left side) or the coolant reservoir tank (right side).
11. Lower the hood.



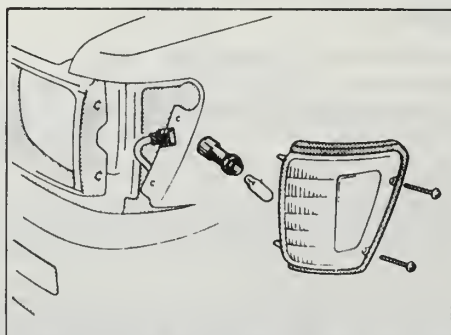
Changing the left headlamp on 1991 Land Cruiser requires removal of several components



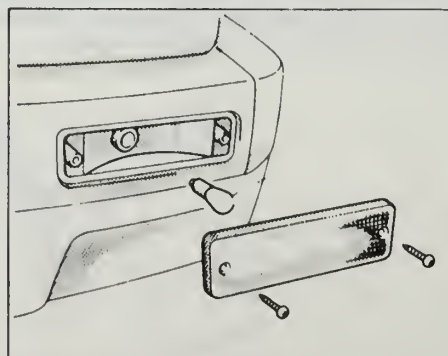
1991 Land Cruiser bulb and housing



ALL MODELS: Rear turn signal, and stop and tail lights



ALL MODELS: Parking and front side marker lights



ALL MODELS: Front turn signal lights

Examples of lens removal and bulb replacement — all models

Signal, Marker and Interior Lamps

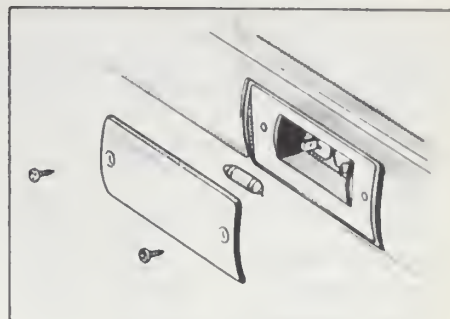
REMOVAL AND INSTALLATION

The lens is removed to allow access to the bulb. External lenses usually have a rubber gasket around them to keep dust and water out of the housing; the gasket must be present and in good condition at reinstallation. Exterior lenses and the larger interior ones are held by one or more screws which must be removed. Once the lens is removed from the body, the bulb is removed from the socket and replaced. For the rear lamps, front marker lamps and some front turn signals, the socket and bulb is removed from the lens with a counter-clockwise turn.

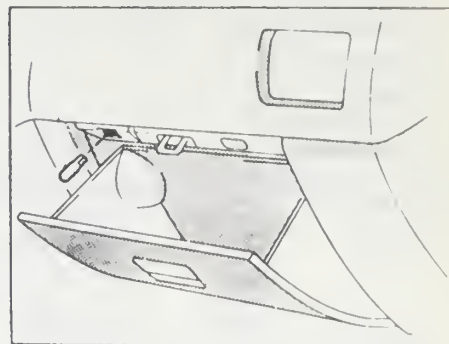
Smaller interior lenses usually fit in place with plastic clips and must be pried or popped out of place. A small, flat, plastic tool is ideal for this job; if other tools are used, care must be taken not to break the lens or the clip.

The lamps used on Toyota trucks are all US standard and may be purchased at any auto store or dealer. Because of the variety of lamps used on any vehicle, take the old one with you when shopping for the replacement.

WARNING: Any light bulb gets hot when operating. If you're removing a good bulb to test or work on the circuit, either wear gloves or disconnect the circuit and allow the lamp to cool before removal. Many of the torpedo-shaped interior lamps can give a nasty burn if grabbed by the unsuspecting.

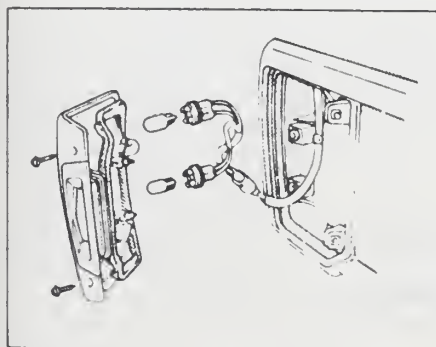


Door courtesy lights

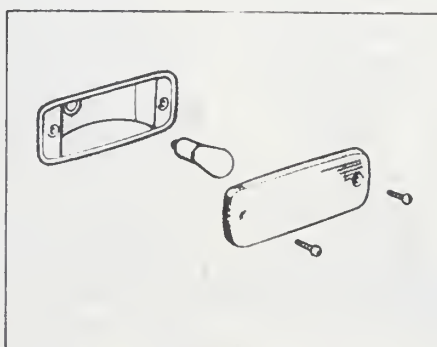


Glovebox light

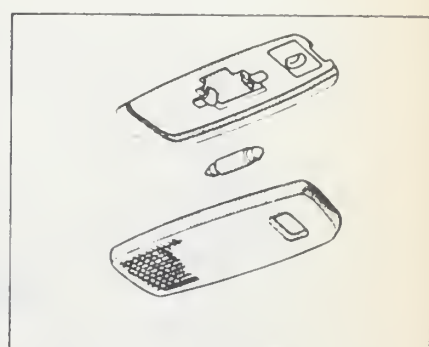
Examples of lens removal and bulb replacement — all models



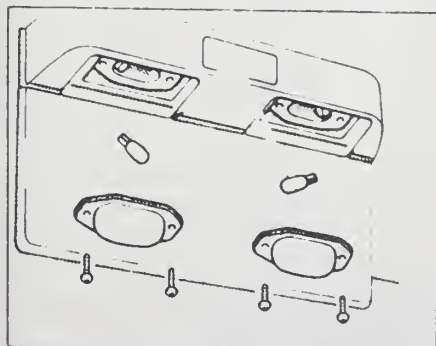
MODELS WITH UNDERFRAME MOUNTED SPARE TIRE
License plate and back up lights



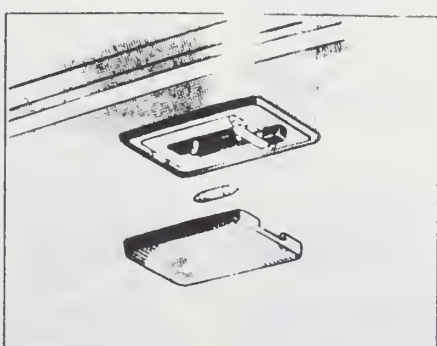
MODELS WITH BACK DOOR MOUNTED SPARE TIRE:
Back up light



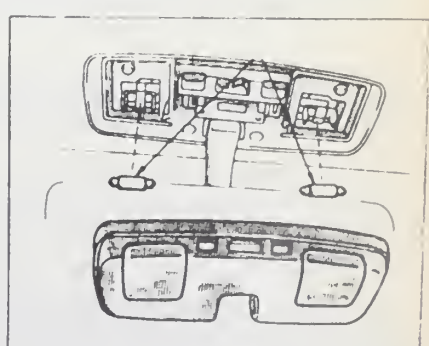
ALL MODELS Luggage compartment light



MODELS WITH BACK DOOR MOUNTED SPARE TIRE
License plate lights



ALL MODELS Interior light



ALL MODELS Personal lights

Examples of lens removal and bulb replacement — all models

6 CHASSIS ELECTRICAL

No.	Light Bulbs	Bulb No.	Wattage
1	Front turn signal lights	1156	27
2	Parking lights	168	5
3	Front side marker lights	194	3.8
4	Rear side marker lights	194	3.8
5	Stop and tail lights	1157	27/8
6	Back-up lights	1156	27
7	Rear turn signal lights	1156	27
8	License plate lights	89	7.5
9	Interior light	—	10
10	Luggage compartment light	—	10
11	Glovebox light	—	1.2

Light bulb application chart — 1989-90 Land Cruiser

No.	Light Bulbs	Bulb No.	Wattage
1	Front turn signal lights	1156	27
2	Parking and front side marker lights	168	5
3	Rear side marker lights	194	3.8
4	Stop and tail lights	1157	27/8
5	Back-up lights	1156	27
6	Rear turn signal lights	1156	27
7	License plate lights	89	5
8	Interior lights*	—	10
9	Personal light	—	10
10	Glovebox light	—	1.4
11	Luggage compartment light	—	10

Light bulb application chart — 1991 Land Cruiser

No.	Light Bulbs	Bulb No.	Wattage
1	Parking lights	—	3.8
2	Front turn signal lights	1156	27
3	Rear turn signal lights	1156	27
4	Stop and tail lights	1157	27/8
5	Back-up lights	1156	27
6	License plate lights	—	3.8
7	Interior lights		
	Normal-cab	—	5
	Xtra-cab		
	Front	—	5
	Rear	—	10
8	Door courtesy lights*	—	3
9	Glovebox light	—	1.4

Light bulb application chart — Truck and 4Runner

TRAILER WIRING

Wiring the truck for towing is fairly easy. There are a number of good wiring kits available and these should be used, rather than trying to design your own. All trailers will need brake lights and turn signals as well as tail lights and side marker lights. Most states require extra marker lights for overly wide trailers. Also, most states have recently required back-up lights for trailers, and most trailer manufacturers have been building trailers with back-up lights for several years.

Additionally, some Class I, most Class II and just about all Class III trailers will have electric brakes.

Add to this number an accessories wire, to operate trailer internal equipment or to charge the trailer's battery, and you can have as many as seven wires in the harness.

Determine the equipment on your trailer and buy the wiring kit necessary. The kit will contain all the wires needed, plus a plug adapter set which included the female plug, mounted on

the bumper or hitch, and the male plug, wired into, or plugged into the trailer harness.

When installing the kit, follow the manufacturer's instructions. The color coding of the wires is standard throughout the industry.

One final point, the best kits are those with a spring loaded cover on the vehicle mounted socket. This cover prevents dirt and moisture from corroding the terminals. Never let the vehicle socket hang loosely. Always mount it securely to the bumper or hitch.

CIRCUIT PROTECTION

Fusible Links

The fusible links serve as main circuit protection for certain high amperage circuits. The Toyota fusible or main links are located at the positive terminal of the battery. Generally, the links are held by terminal bolts and may be removed with a screwdriver, although some may be the crimp type. Always disconnect the negative battery cable before replacing the link(s). If the link failed, it was due to a high amperage load passing through the circuit; find the cause or the new link will fail again.

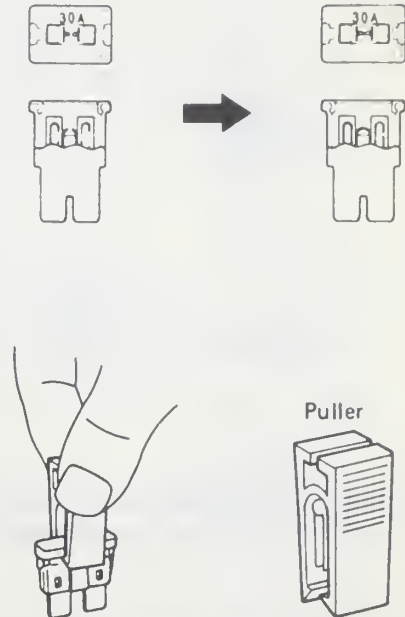
The fuse link is a short length of special, high temperature insulated wire, integral with the wiring harness and should not be confused with standard wire. It is several wire gauges smaller than the circuit which protects. Under no circumstances should a fuse link replacement repair be made using a length of standard wire cut from bulk stock or from another wiring harness.

To repair any blown fuse link which cannot be unbolted, use the following procedure:

1. Determine which circuit is damaged, its location and the cause of the open fuse link. If the damaged fuse link is one of three fed by a common No. 10 or 12 gauge feed wire, determine the specific affected circuit.
2. Disconnect the negative battery cable.
3. Cut the damaged fuse link from the wiring harness and discard it.
4. Identify and procure the proper fuse link and butt connectors for attaching the fuse link to the harness.
5. To replace any fuse link on a single circuit in a harness, cut out the damaged portion, strip approximately $\frac{1}{2}$ in. of insulation from the two wire ends and attach the appropriate replacement fuse link to the stripped wire ends with two proper size butt connectors. Solder the connectors and wires and insulate with tape.
6. To repair any fuse link which has an eyelet terminal on one end of such as the charging circuit, cut off the open fuse link behind the weld, strip approximately $\frac{1}{2}$ in. of insulation from the cut end and attach the appropriate new eyelet fuse link to the cut stripped wire with an appropriate size butt connector. Solder the connectors and wires at the repair and insulate with tape.
7. Connect the negative battery cable to the battery and test the system.

Fuses

The fuse block is located below the left side of the instrument panel on all vehicles. Additional fuses are found on the



Always use a replacement fuse of the same rating as the failed one. Using the fuse puller makes removal much easier

underhood relay board. The radio or audio unit is protected by an additional fuse in the body of the unit. In the event that anything electrical isn't working, the fuse should be the first item checked.

The underdash or underhood fusebox contains a fuse puller which can be used to grip and remove the fuse. The fuse cannot be checked while in the fuseblock; it must be removed. View the fuse from the side, looking for a broken element in the center. Sometimes the break is hard to see; if you can't check the fuse with an ohmmeter for continuity, replace the fuse.

If a fuse should blow, turn off the ignition switch and also the circuit involved. Replace the fuse with one of the same amperage rating, and turn on the switches. If the new fuse immediately blows out, the circuit should be tested for shorts, broken insulation, or loose connections.

NOTE: Do not use fuses of a higher amperage than recommended.

6 CHASSIS ELECTRICAL

Relays

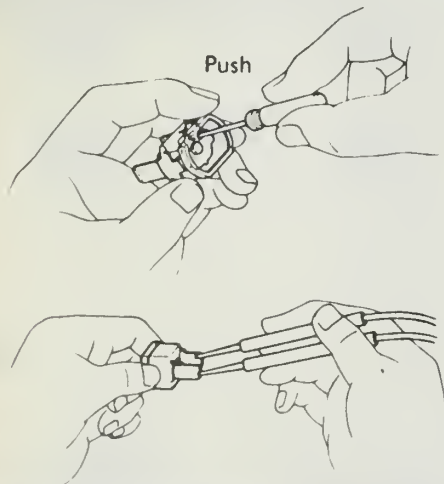
As vehicles rely more and more on electronic systems and electrically operated options, the number of relays grows steadily. Many relays are located in logical positions on the relay and fuse board under the dash or in the engine compartment. However, many relays are located throughout the vehicle, often near the component they control. During diagnosis of a circuit, always suspect a failed relay until proven otherwise. Sometimes, a solid rap with the handle of a screwdriver will free an internally stuck relay and restore the system to operation. This isn't always the case, but when it works you'll brag about it for weeks.

Circuit Breakers

Many circuits, particularly high amperage ones, are protected by resettable circuit breakers. Much like the circuit breakers in a household system, these units will trip when too much current attempts to pass through. On Toyota vehicles, the breaker does not automatically reset, but may be reset manually.

To reset the breaker:

1. Disconnect the negative battery cable.



Reset the circuit breaker with a very thin tool and check it for continuity before reinstallation

2. Remove the circuit breaker.
3. Use a needle probe or other thin tool to reach into the reset hole and push the reset button.
4. Once reset, use an ohmmeter to check for continuity at the pins of breaker. If no continuity is present, the breaker did not reset.
5. Reinstall the circuit breaker and connect the negative battery cable.

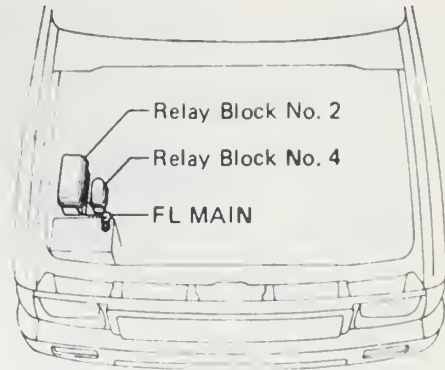
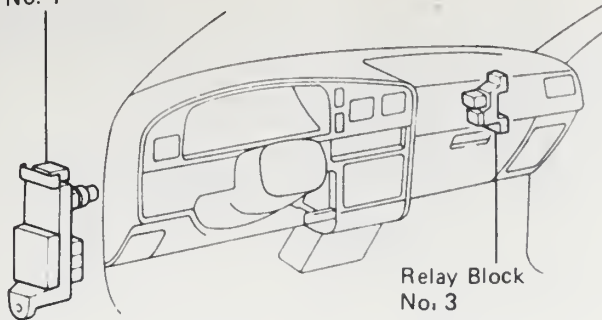
Communication and "Add-on" Electrical Equipment

The electrical system in your car is designed to perform under reasonable operating conditions without interference between components. Before any additional electrical equipment is installed, it is recommended that you consult your Toyota dealer or a reputable repair facility familiar with the vehicle and its systems.

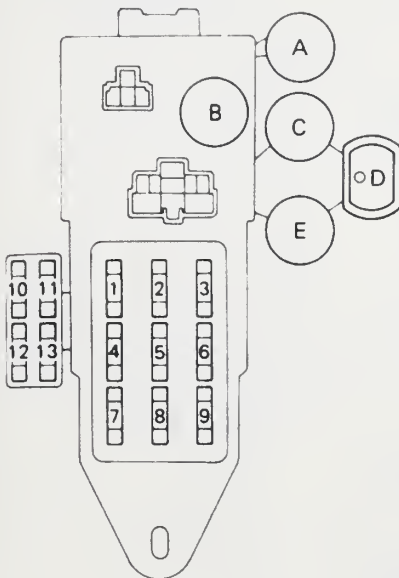
If the vehicle is equipped with mobile radio equipment (CB, HAM, Business radio and/or mobile telephone) it may have an effect upon the operation of the electric fuel injection and other engine systems. Radio frequency interference (RFI) from the communications system can be picked up by the car's wiring harnesses and conducted into the computer, giving it the wrong messages at the wrong time. Although well shielded against RFI, the controller should be further protected through the following steps:

1. Install the antenna as far as possible from the any computer. Since the ECM is located in the passenger compartment, the antenna should be mounted at the rear of the car.
2. Keep the antenna wiring a minimum of eight inches away from any wiring running to the computer and from the computer itself. NEVER wind the antenna wire around any other wiring.
3. Mount the equipment as far from the computer as possible. Be very careful during installation not to drill through any wires or short a wire harness with a mounting screw.
4. Insure that the electrical feed wire(s) to the equipment are properly and tightly connected. Loose connectors can cause interference.
5. Make certain that the equipment is properly grounded to the car. Poor grounding can damage expensive equipment.
6. Make sure the antenna is "trimmed" or adjusted for optimum function.

Junction Block No. 1



Junction Block No. 1



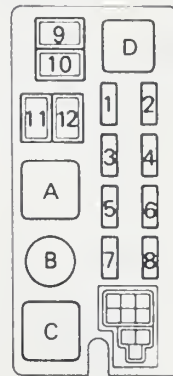
Fuses

1. ENGINE	10A
2. IGN	7.5A
3. TAIL	15A
4. WIPER	20A
5. GAUGE	10A
6. STOP	15A
7. RADIO	7.5A
8. CIG	15A
9. TURN	10A
10. RR ANTI LOCK	15A
11. —	—
12. ECU-IG	20A
13. DEFOG	20A

Relays and Circuit Breaker

- A. Starter Relay
- B. Taillight Control Relay
- C. Defogger Relay
- D. Power (CB)
- E. Moon Roof Relay

Relay Block No. 2



Fuses

1. CHARGE	7.5A
2. EFI	15A
3. HAZ-HORN	15A
4. DOME	15A
5. HEAD (RH)	10A
6. HEAD (LH)	10A
7. —	—
8. —	—
9. ALT (H-Fuse) (22R-E A/T)	80A 100A
10. —	—
11. AM1 (H-Fuse)	40A
12. AM2 (H-Fuse)	30A

Relays

- A. Headlight Control Relay
 - B. EFI Relay
- (CANADA Models)

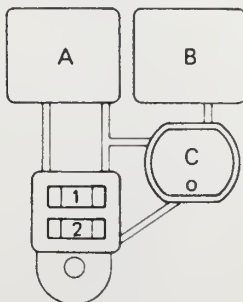
Fuses

5. HEAD (RH-LO)	10A
6. HEAD (LH-LO)	10A
7. HEAD (RH-HI)	10A
8. HEAD (LH-HI)	10A

Relays

- D. Dimmer Relay

Relay Block No. 3



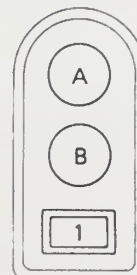
Fuses

1. A/C	10A
2. RR HEATER	20A

Relays and Circuit Breaker

- A. RR Heater Relay
- B. Heater Relay
- C. Heater (CB)

Relay Block No. 4



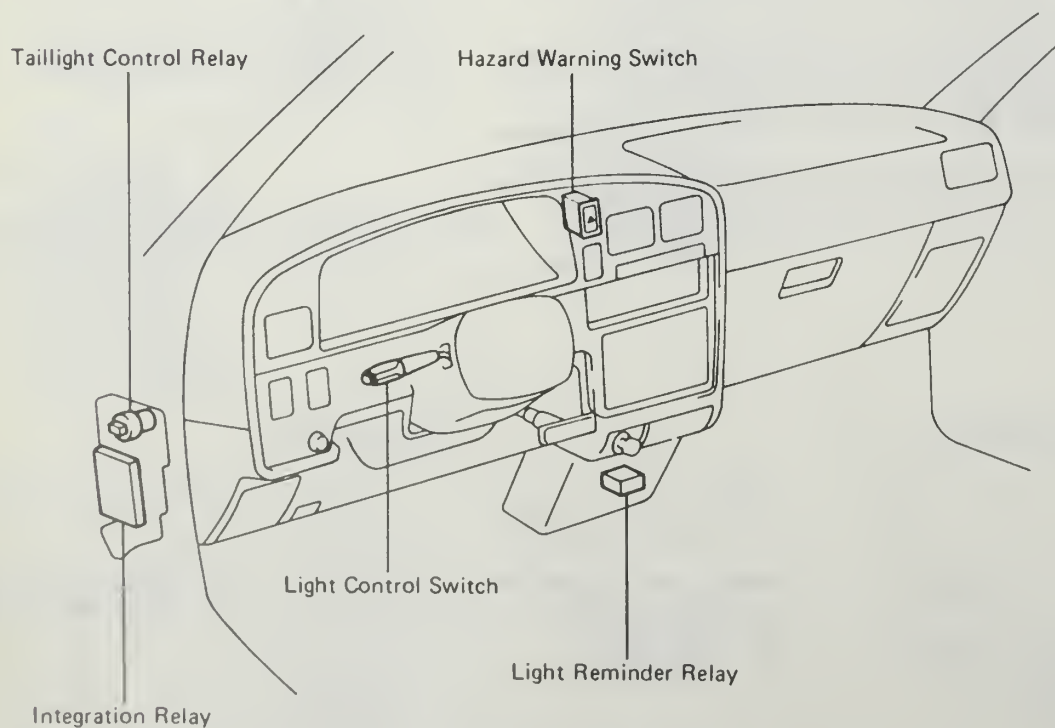
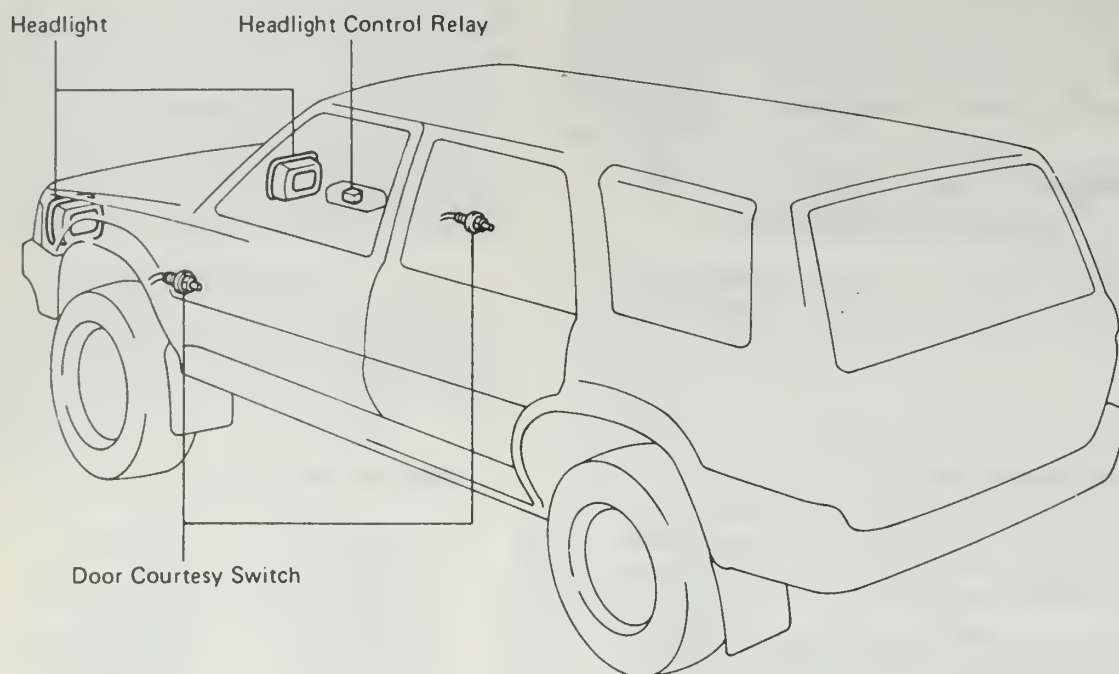
Fuse

1. CDS FAN	30A
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Relays

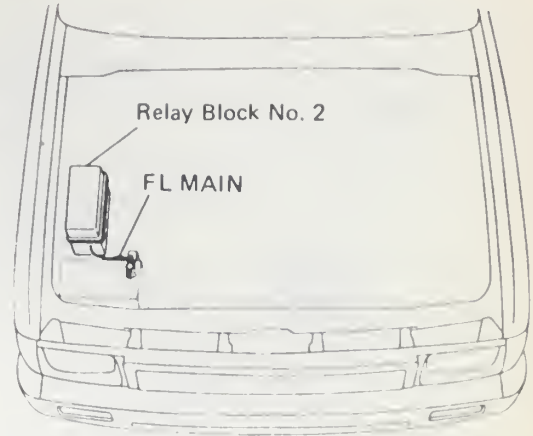
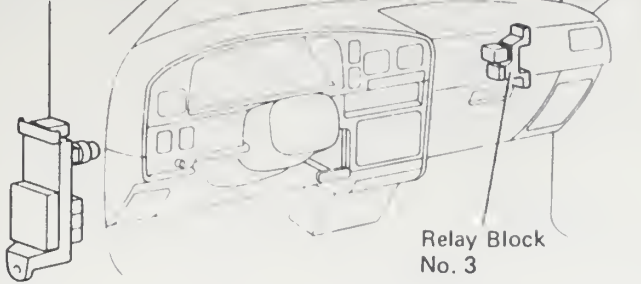
- A. CDS FAN No. 1 Relay
- B. CDS FAN No. 2 Relay

6 CHASSIS ELECTRICAL

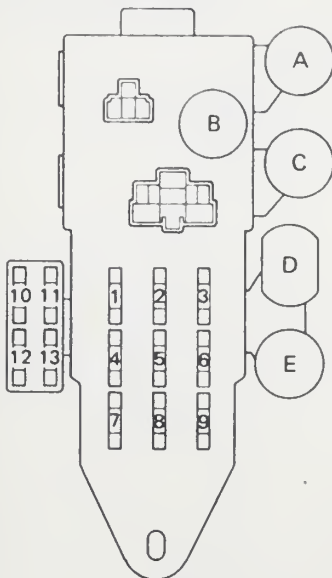


Lighting switch and relay locations — 4Runner

Junction Block No. 1



Junction Block No. 1



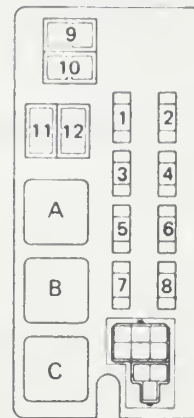
Fuses

1. ENGINE	10A
2. IGN	7.5A
3. TAIL	15A
4. WIP	20A
5. GAUGE	10A
6. STOP	15A
7. RADIO	7.5A
8. CIG	15A
9. TURN	10A
10. —	—
11. —	—
12. ECU-IG	20A
13. DEFOG	15A

Relays and Circuit Braker

- A. Starter or Back Up Relay
- B. Taillight Control Relay
- C. Defogger Relay [w/o Power Window]
- D. Power (CB)
- E. Defogger Relay [w/ Power Window]

Relay Block No. 2



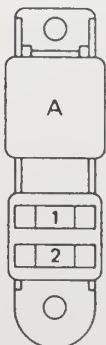
Fuses

1. CHARGE	7.5A
2. EFI	15A
3. HAZ-HORN	15A
4. DOME	15A
5. HEAD (RH)	10A
6. HEAD (LH)	10A
7. —	—
8. —	—
9. ALT (FL)	80A
10. —	—
11. AM1 (FL)	40A or 60A
12. AM2 (FL)	30A

Relays

- A. Headlight Control Relay
- B. EFI Relay
- C. CMH Relay

Relay Block No. 3



Fuses

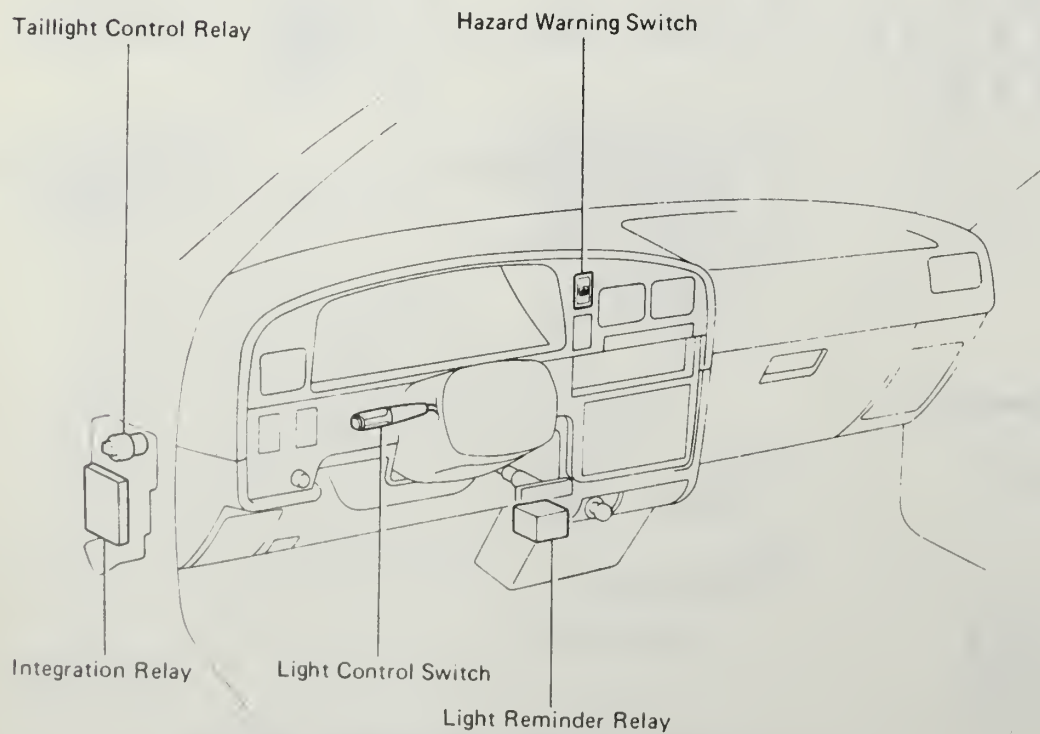
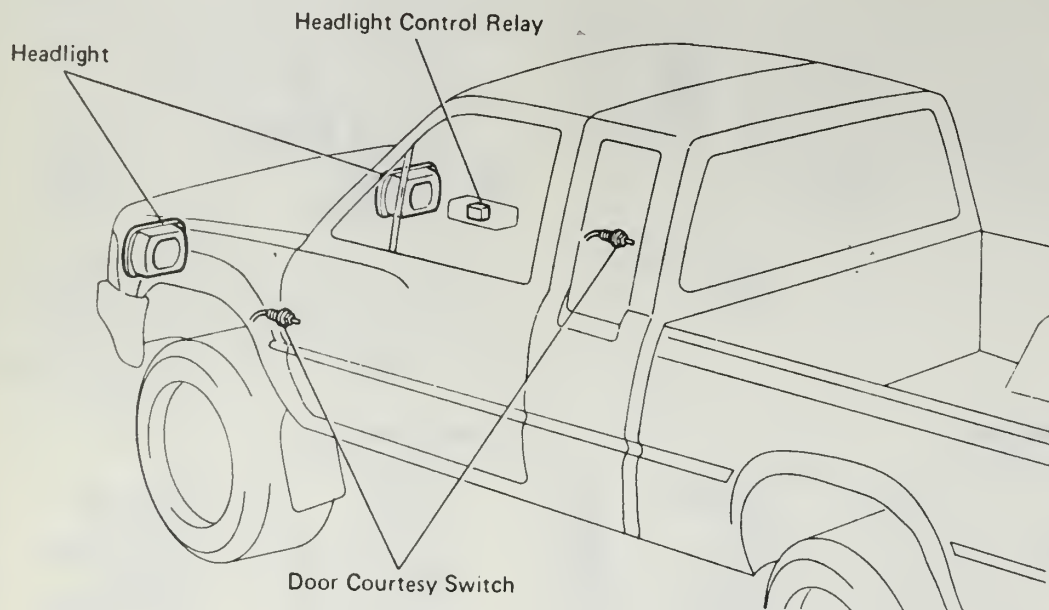
1. A/C	10A
2. HEATER	30A

Relay

- A. Heater Relay

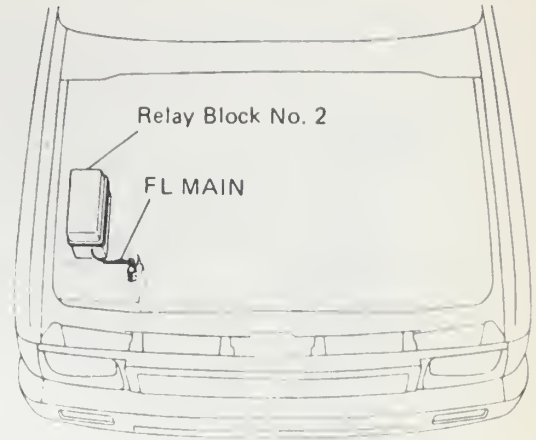
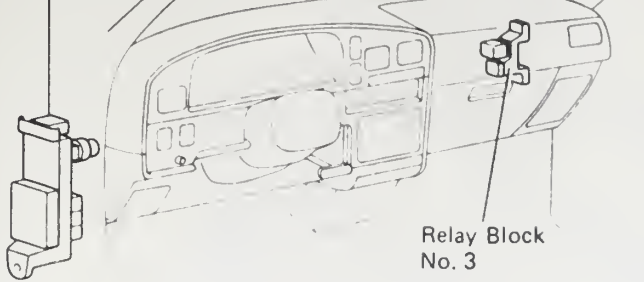
Fuse, relay and circuit breaker locations — 1989-90 Truck

6 CHASSIS ELECTRICAL

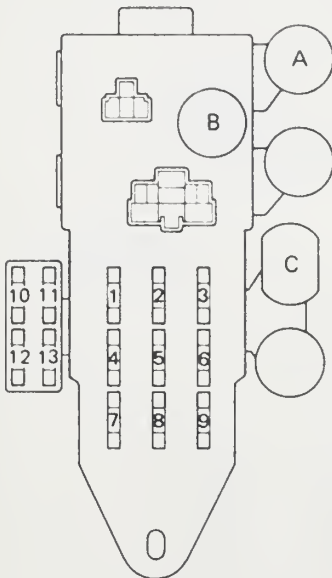


Lighting switch and relay locations — 1989-90 Truck

Junction Block No. 1



Junction Block No. 1

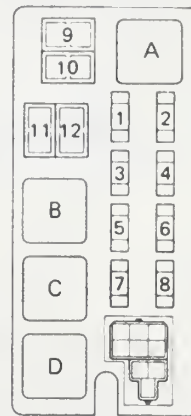


Fuses

1. ENGINE	10A
2. IGN	7.5A
3. TAIL	15A
4. WIPER	20A
5. GAUGE	10A
6. STOP	15A
7. RADIO	7.5A
8. CIG	15A
9. TURN	10A
10. REAR ANTILOCK	15A
11. —	—
12. ECU-IG	20A
13. —	—

Relays and Circuit Braker
 A. Starter or Back Up Relay
 B. Taillight Control Relay
 C. Power (CB)

Relay Block No. 2



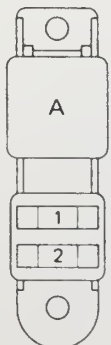
Fuses

1. CHARGE	7.5A
2. EFI	15A
3. HAZ-HORN	15A
4. DOME	15A
5. (USA) HEAD (RH)	10A
6. (USA) HEAD (LH)	10A
7. —	—
8. —	—
9. ALT (H-fuse)	80A
10. —	—
11. AM1 (H-fuse)	40A or 60A
12. AM2 (H-fuse) (CANADA)	30A
5. HEAD LO (RH)	10A
6. HEAD LO (LH)	10A
7. HEAD HI (RH)	10A
8. HEAD HI (LH)	10A

Relays

- A. (CANADA) Headlight Dimmer Relay
- B. Headlight Control Relay
- C. EFI Relay
- D. CMH Relay

Relay Block No. 3



Fuses

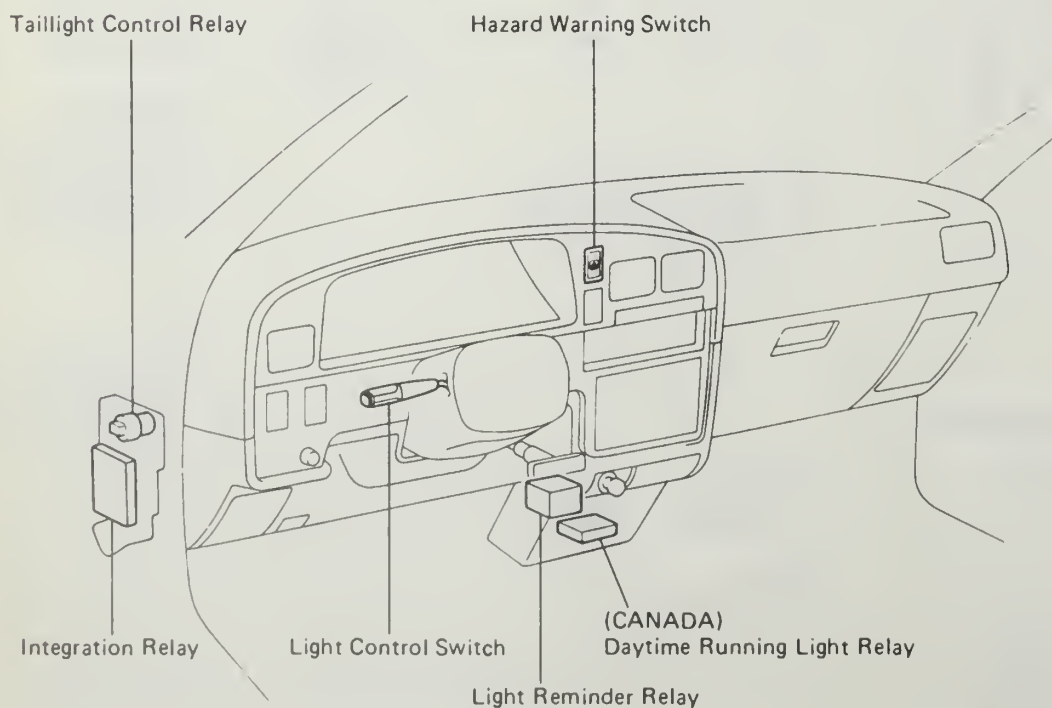
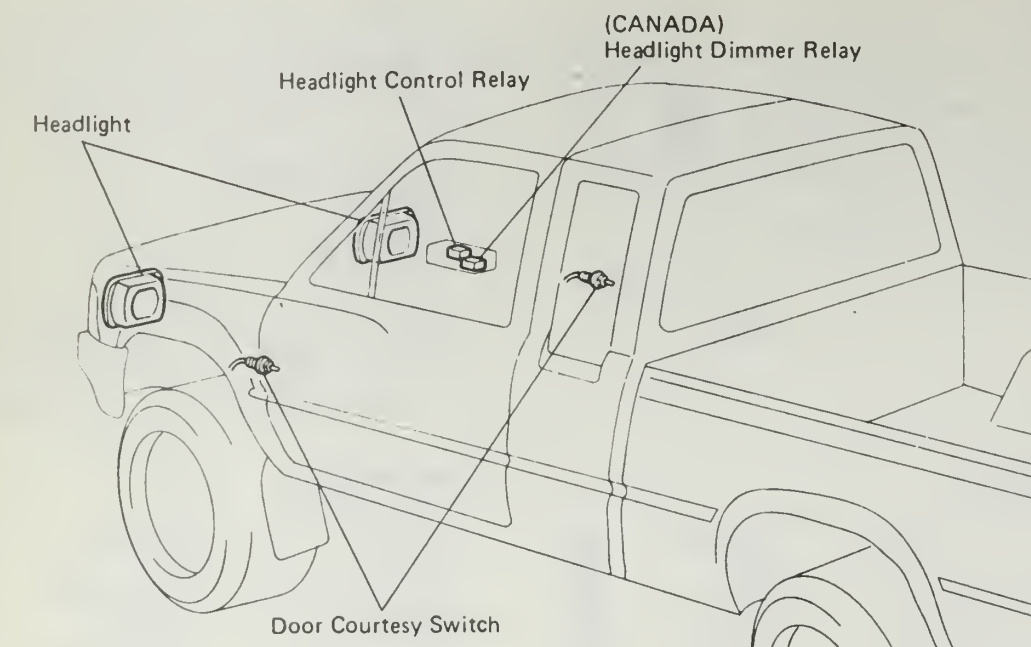
1. A/C	10A
2. HEATER	30A

Relay

- A. Heater Relay

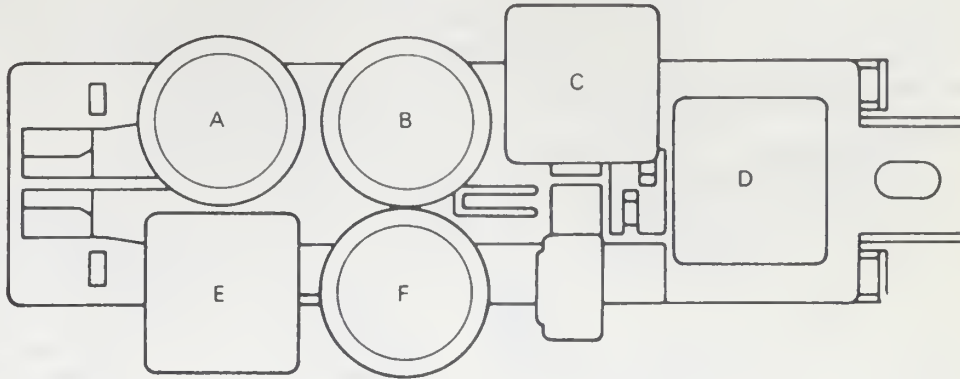
Fuse, relay and circuit breaker locations — 1991 Truck

6 CHASSIS ELECTRICAL



Lighting switch and relay locations – 1991 Truck

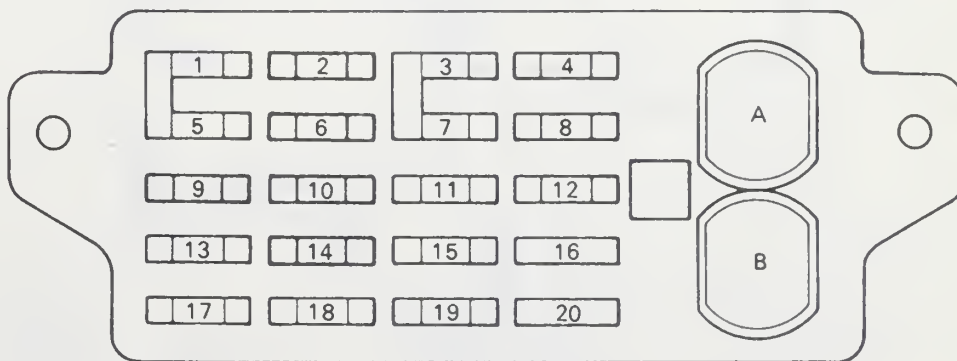
Relay Block



Relays

- | | |
|----------------------------|----------------------------|
| A. Taillight Control Relay | D. Turn Signal Flasher |
| B. Front Drive Relay | E. Headlight Control Relay |
| C. Front Heater Relay | F. Ignition Main Relay |

Fuse Block



Fuses

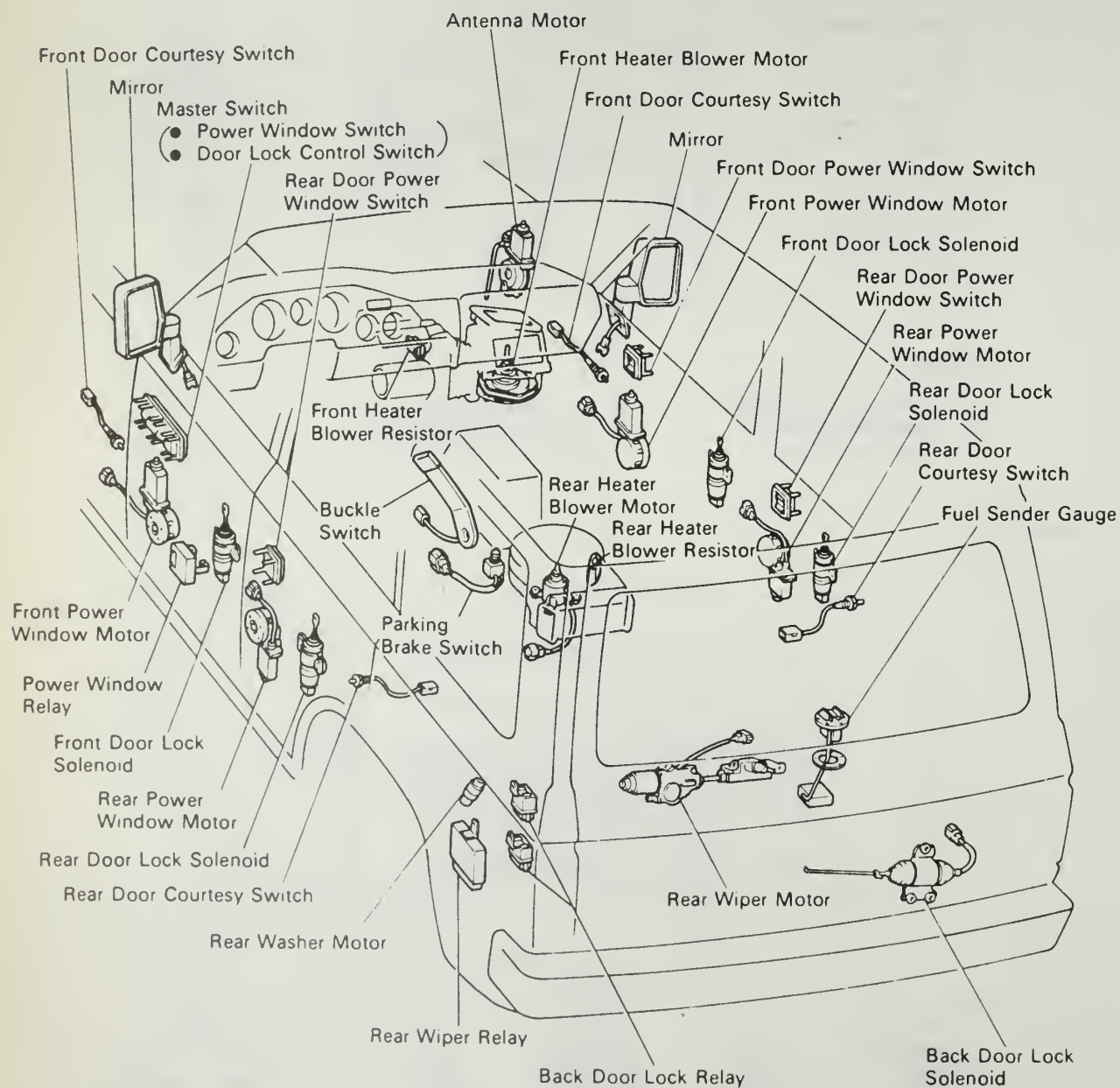
1. HEAD (RH)	15A	11. A/C	10A
2. TAIL	15A	12. GAUGE	7.5A
3. TURN	7.5A	13. DOOR	15A
4. DOOM	7.5A	14. ENGINE	10A
5. HEAD (LH)	15A	15. -	
6. STOP	15A	16. SPARE	7.5A
7. WIPER	20A	17. EFI	15A
8. CHARGE	7.5A	18. IGN	7.5A
9. CIG	15A	19. DEFOG	20A
10. HAZ-HORN	15A	20. SPARE	15A

Circuit Breakers

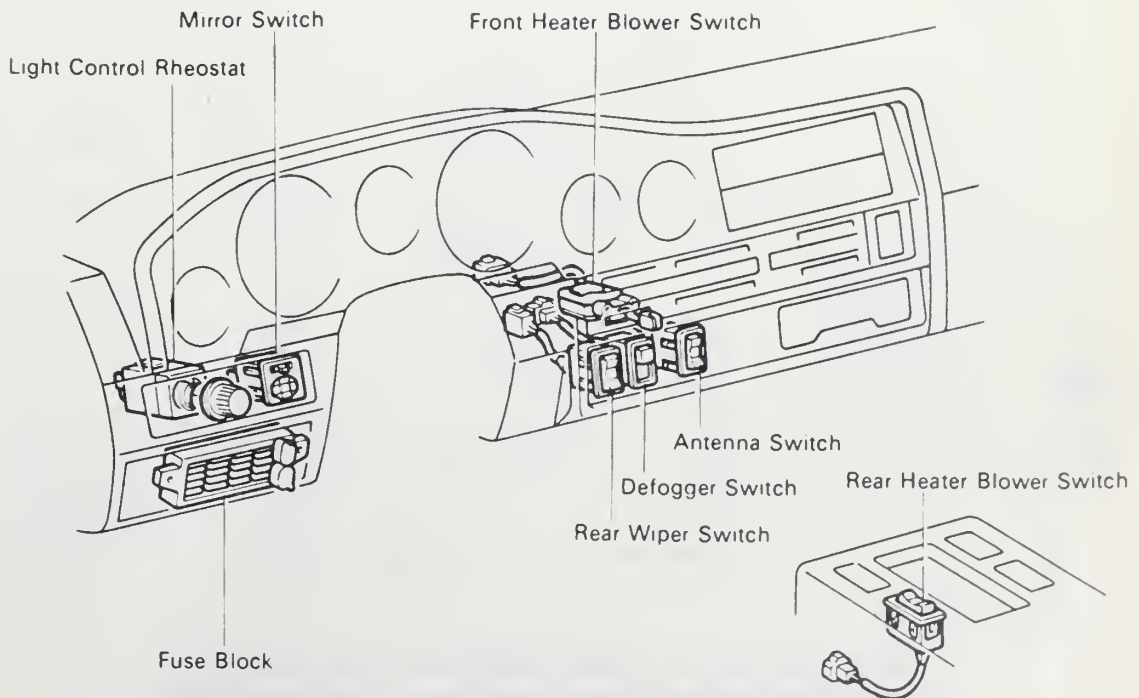
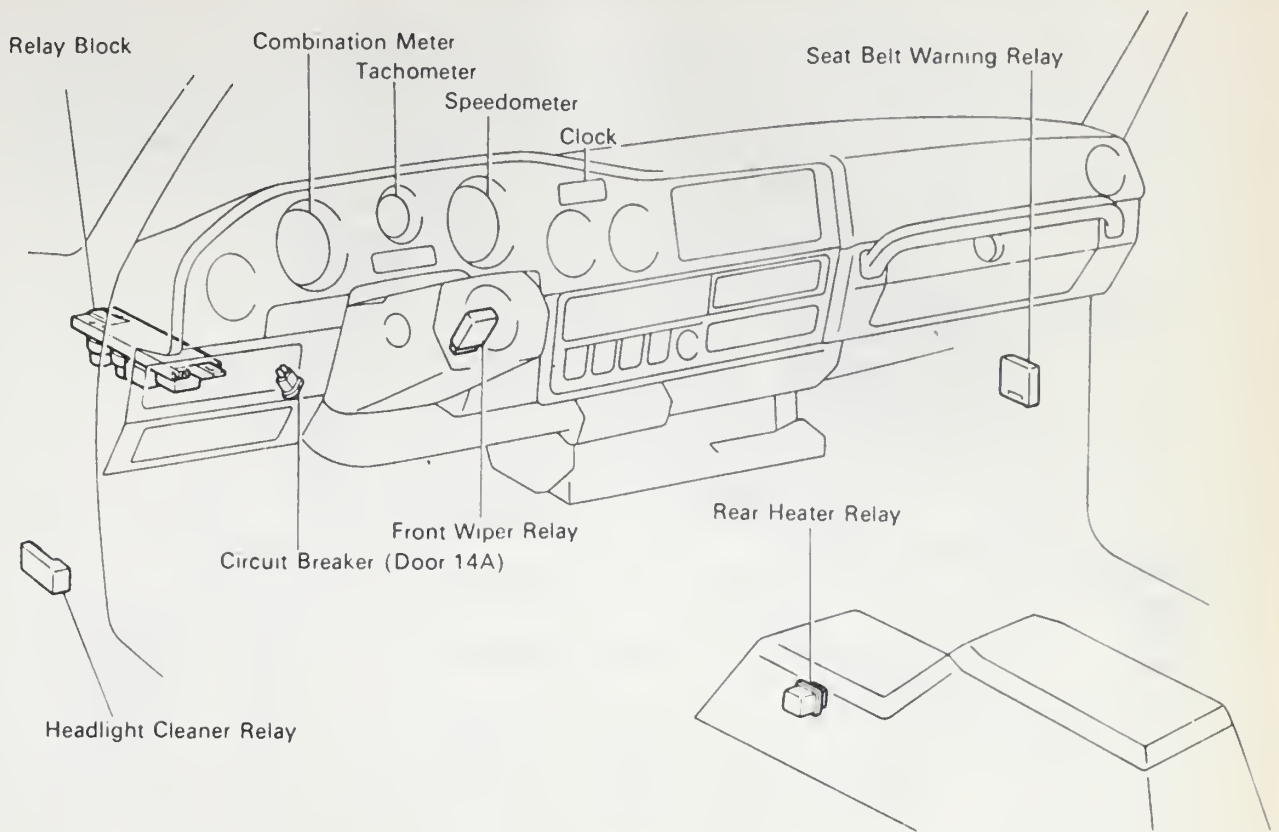
A. Heater	30A
B. Power	30A

Fuse, relay and circuit breaker locations — 1989-90 Land Cruiser

6 CHASSIS ELECTRICAL

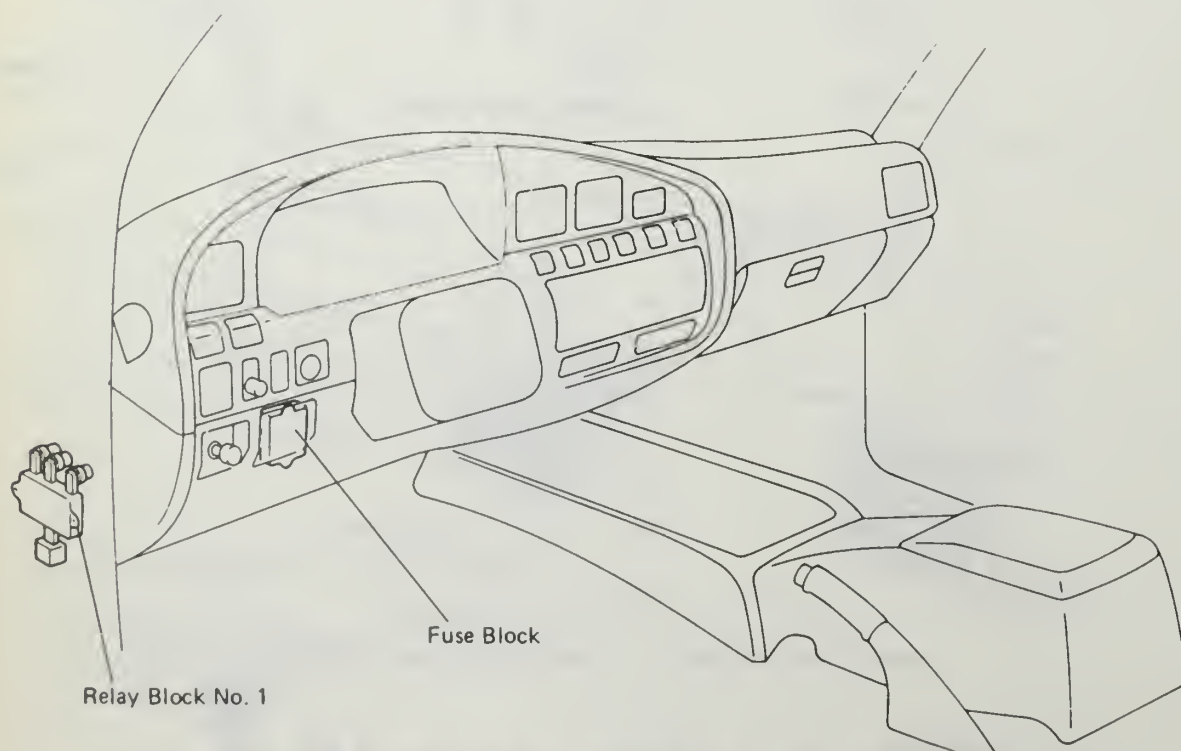


Switches, Relays and Motors — 1989-90 Land Cruiser



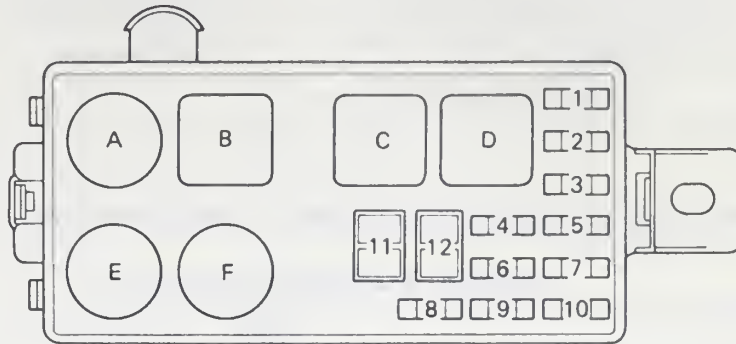
Dashboard switches and relays — 1989-90 Land Cruiser

6 CHASSIS ELECTRICAL



Relay blocks, fuse blocks, and fusible links — 1991 Land Cruiser

Relay Block No. 2 (Engine Room)



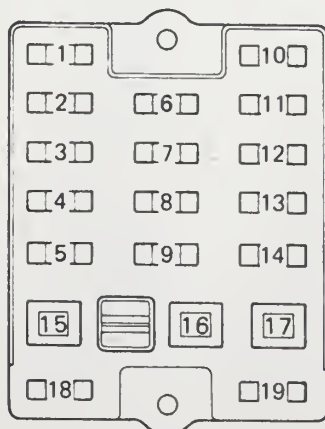
Fuse and High Current Fuses

1. HEAD (RH)	15A	7. HAZ-HORN	15A
2. HEAD (LH)	15A	8. —	
3. —		9. —	
4. CHARGE	7.5A	10. DOME	10A
5. —		11. AM1	50A
6. EFI	15A	12. —	

Relays

A. EFI Main Relay
B. Charge Light Relay
C. Headlight Control Relay
D. —
E. Horn Relay
F. —

Fuse Block (Instrument Panel)



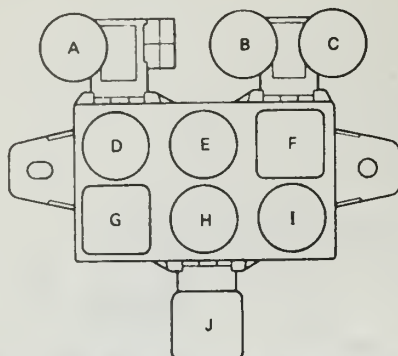
Fuse and Medium Current Fuse

1. CIG	15A	10. ECU-B	10A
2. TAIL	15A	11. REAR-HTR	20A
3. —		12. IGN	7.5A
4. STOP	10A	13. A/C	10A
5. DEFOG	20A	14. DIFF	20A
6. WIPER	20A	15. —	
7. GAUGE	10A	16. HEATER	30A
8. TURN	7.5A	17. POWER	30A
9. ECU-IG	15A	18. Spear	
		19. Spear	

Fuse, relay and circuit breaker location — 1991 Land Cruiser

6 CHASSIS ELECTRICAL

Relay Block No. 1 (Cowl Side)



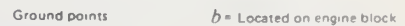
Relay

- A. Cooling Fan Relay
- B. Blower Hi Relay
- C. —
- D. Defogger Relay
- E. Power Main Relay
- F. Turn Signal Flasher
- G. Heater Relay
- H. Taillight Control Relay
- I. —
- J. Circuit Opening Relay

Fuse, relay and circuit breaker location — 1991 Land Cruiser

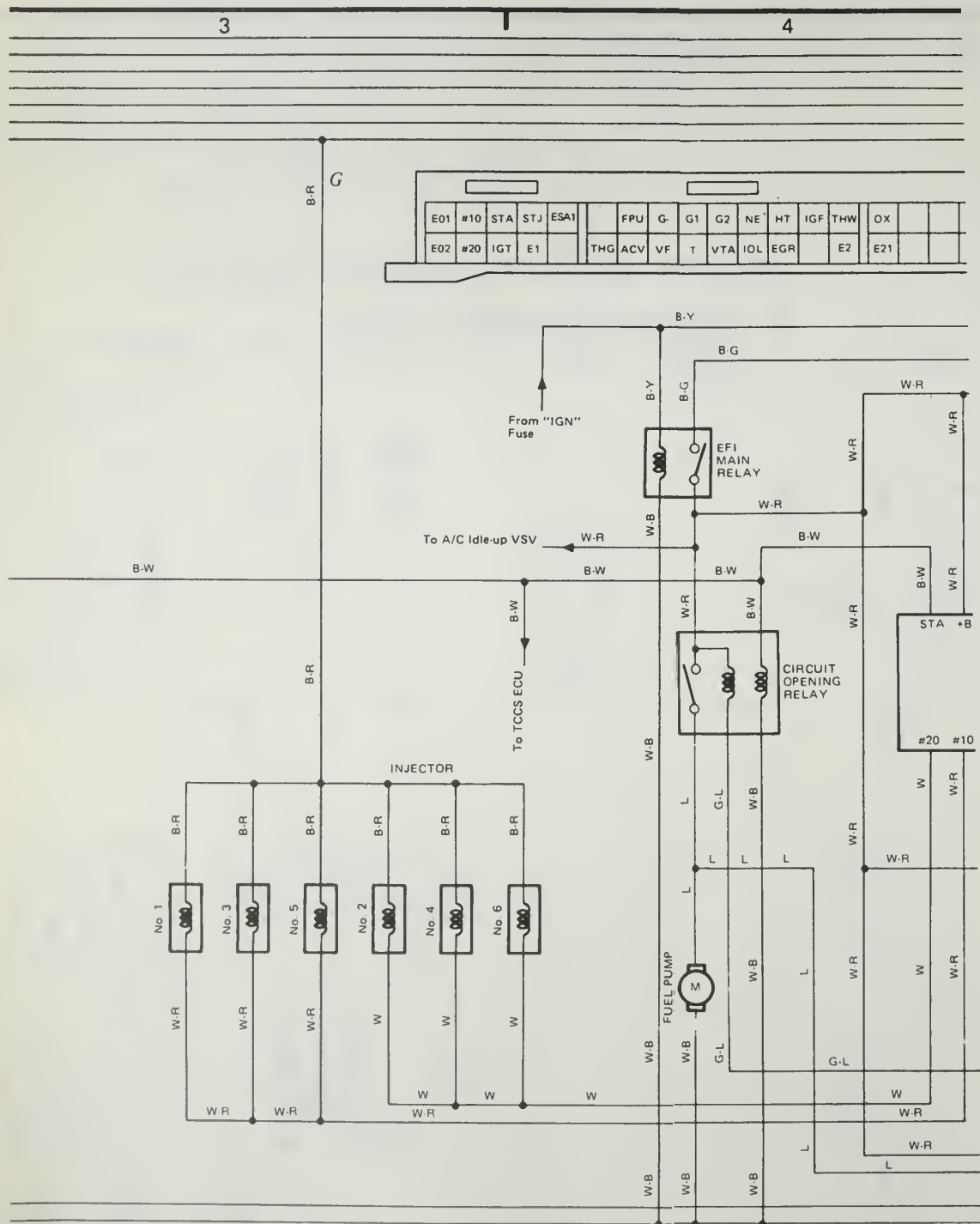
TORQUE SPECIFICATIONS

Component	English	Metric
Expansion valve-to-inlet fitting		
Land Cruiser and Trucks:	17 ft. lbs.	23 Nm
4Runner:	48 inch lbs.	5 Nm
Liquid tube-to-expansion valve		
Land Cruiser and Trucks:	10 ft. lbs.	13 Nm
4Runner:	48 inch lbs.	5 Nm
Suction tube-to-evaporator:	48 inch lbs.	5 Nm
Liquid tube-to-evaporator:	10 ft. lbs.	13 Nm
Suction hose-to-outlet fitting:	24 ft. lbs.	32 Nm
Receiver/dryer liquid lines:	10 ft. lbs.	13 Nm
Wiper motor pivot nut:	8 ft. lbs.	11 Nm
Wiper arm acorn nut:	48 inch lbs.	5 Nm



6-45

6 CHASSIS ELECTRICAL

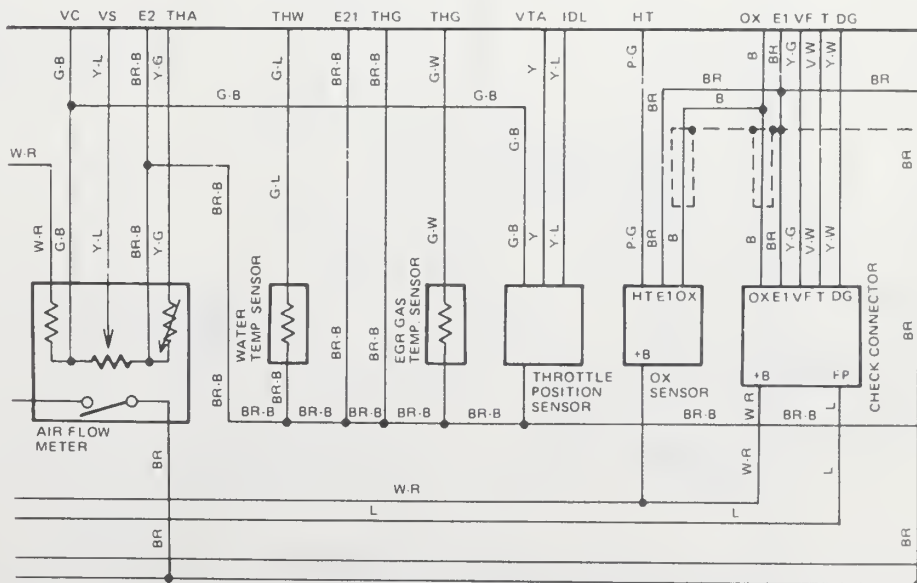
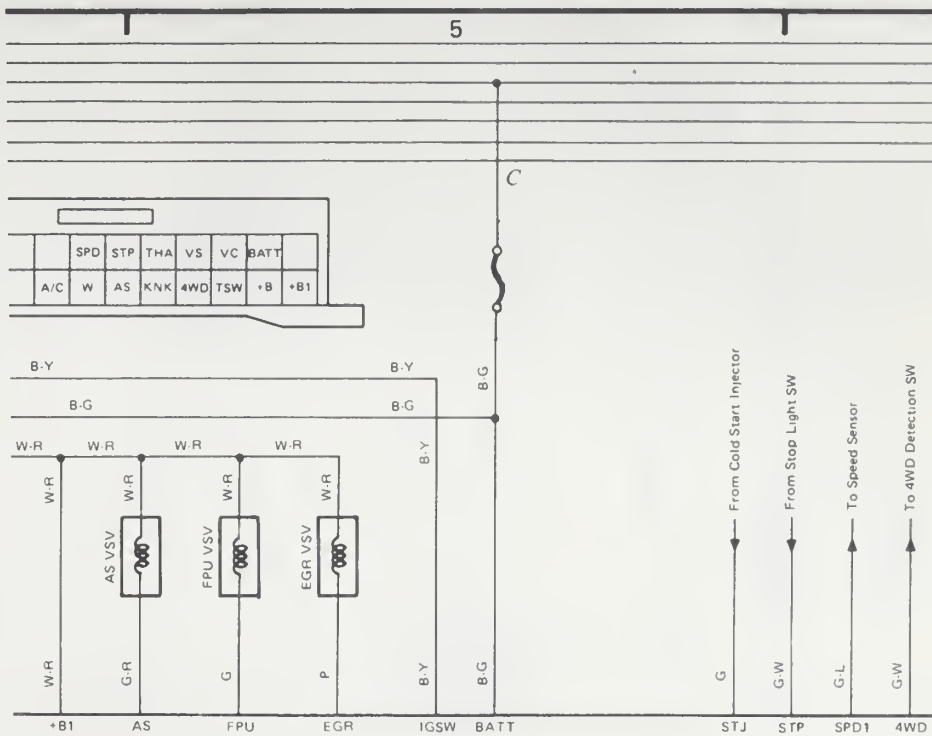


C = Located on left front pillar

Wiring diagram — 1989 truck

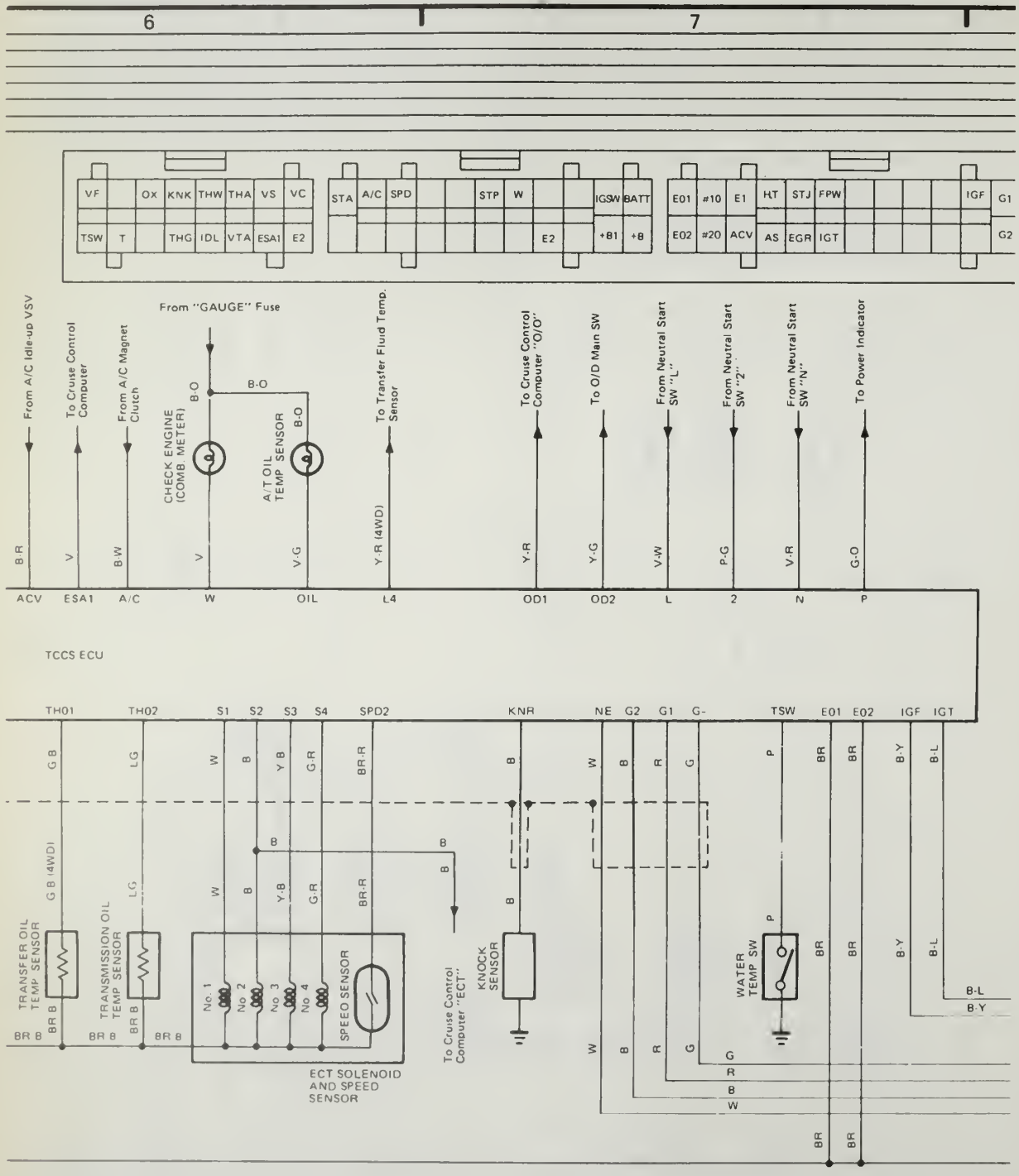
TCCS

TCCS (3VZ-E)

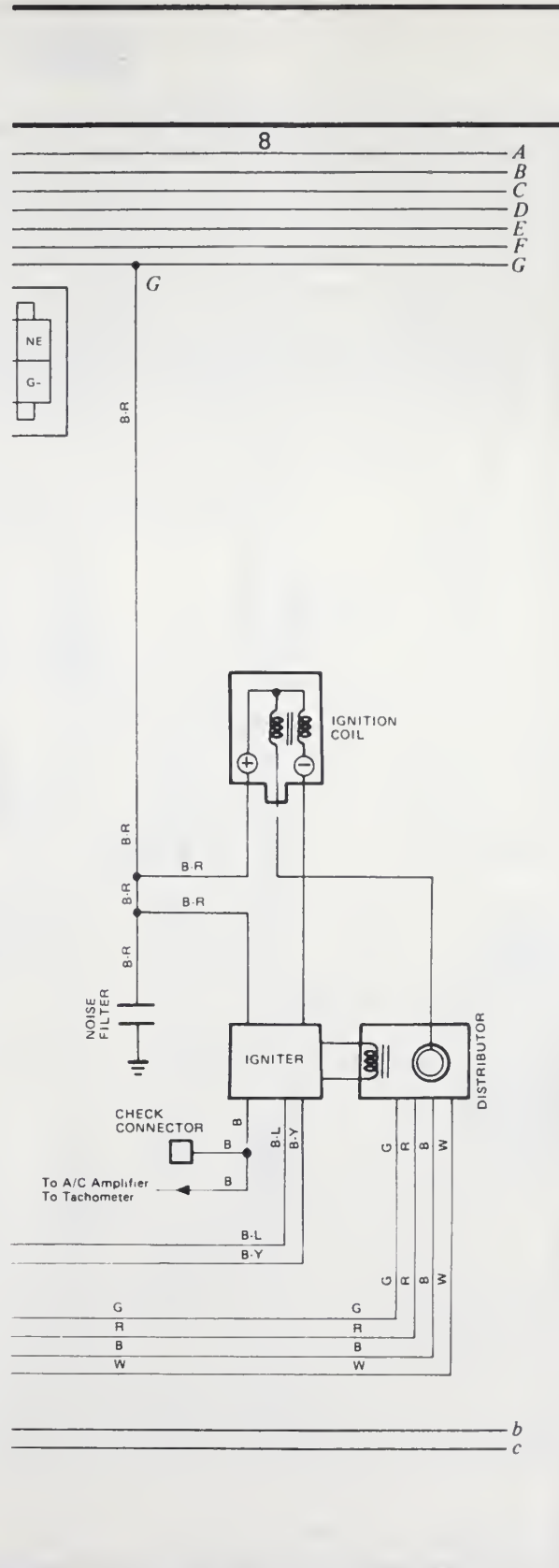


Wiring diagram – 1989 truck

6 CHASSIS ELECTRICAL

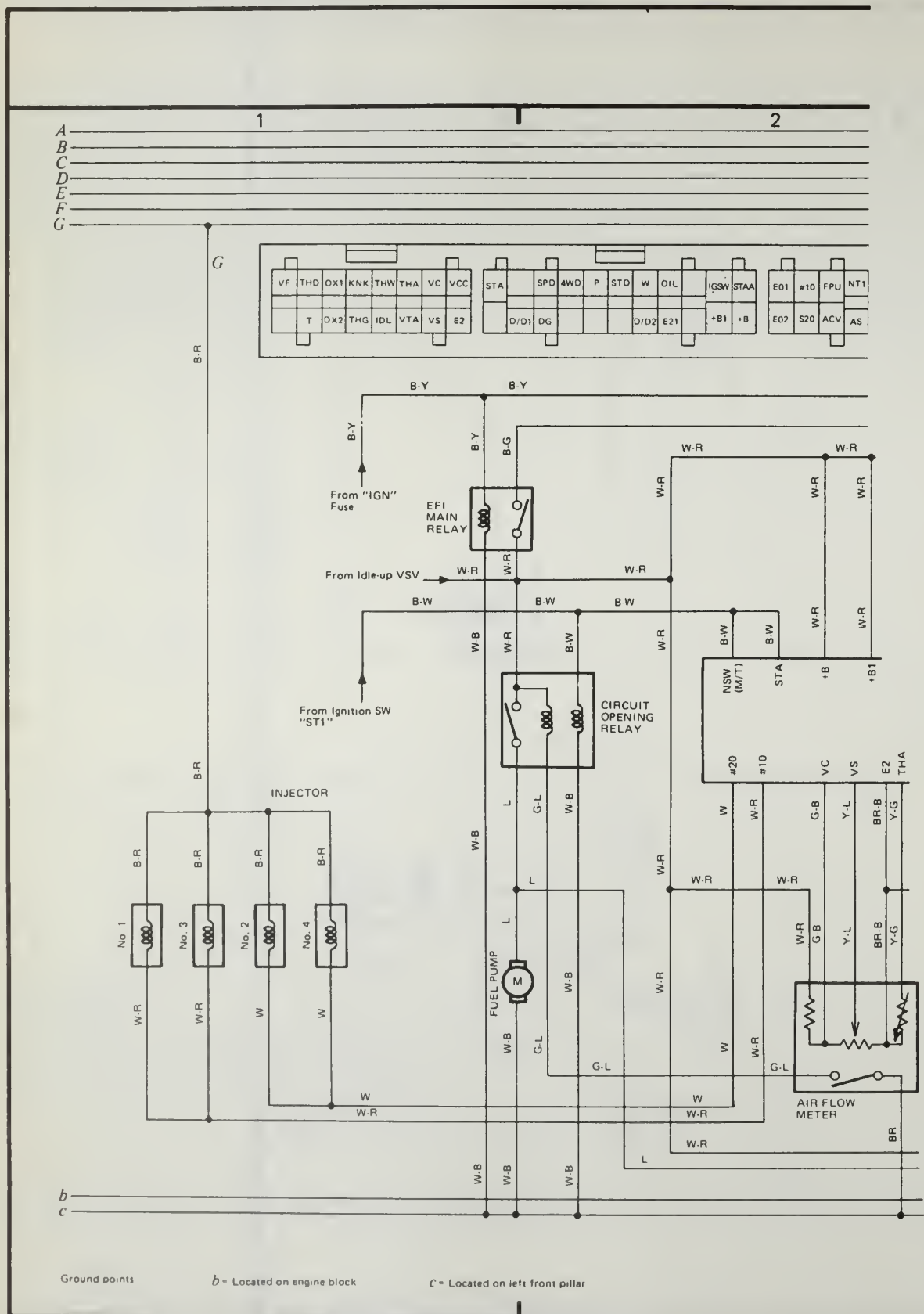


Wiring diagram — 1989 truck

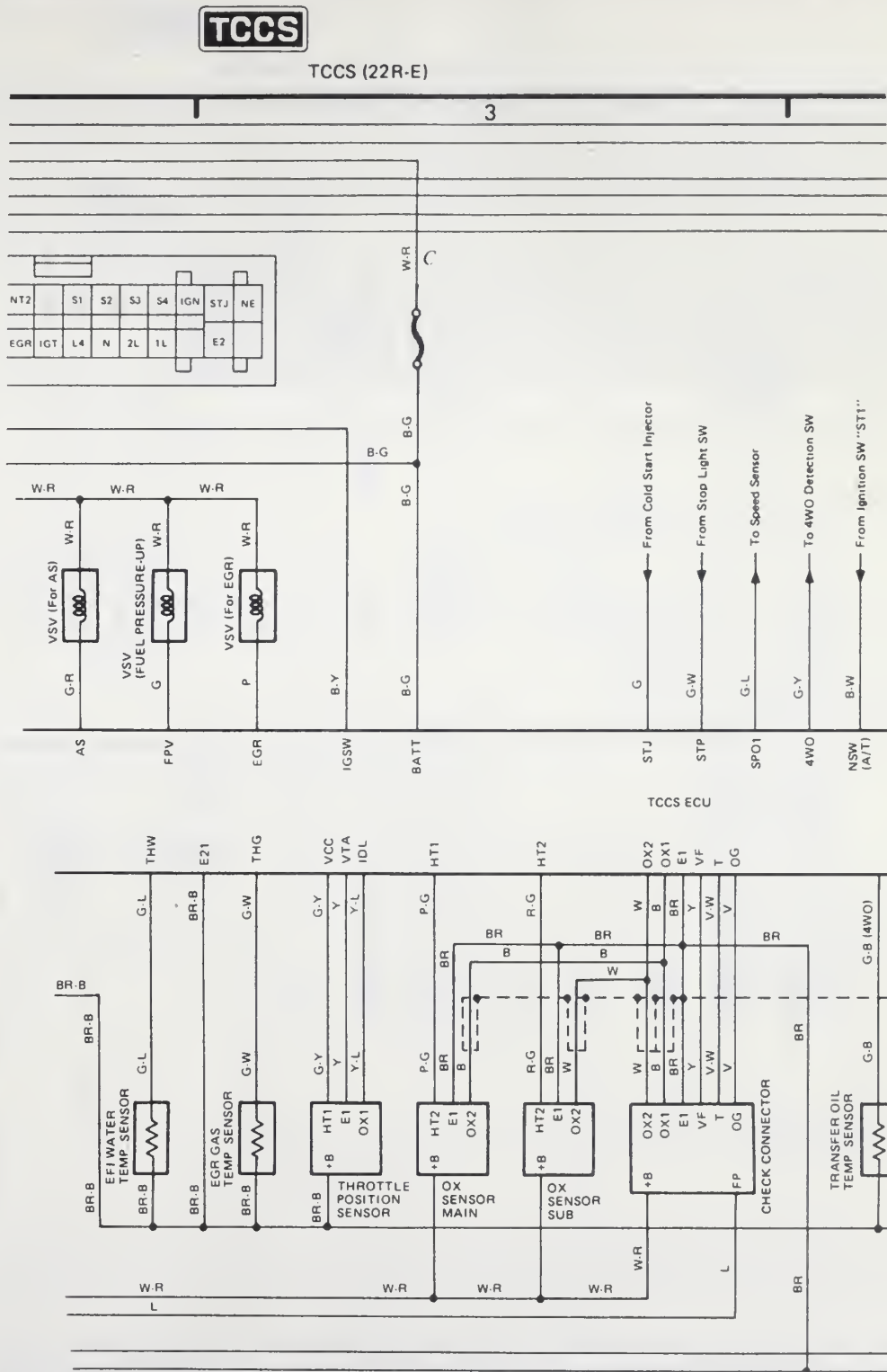


Wiring diagram – 1989 truck

6 CHASSIS ELECTRICAL

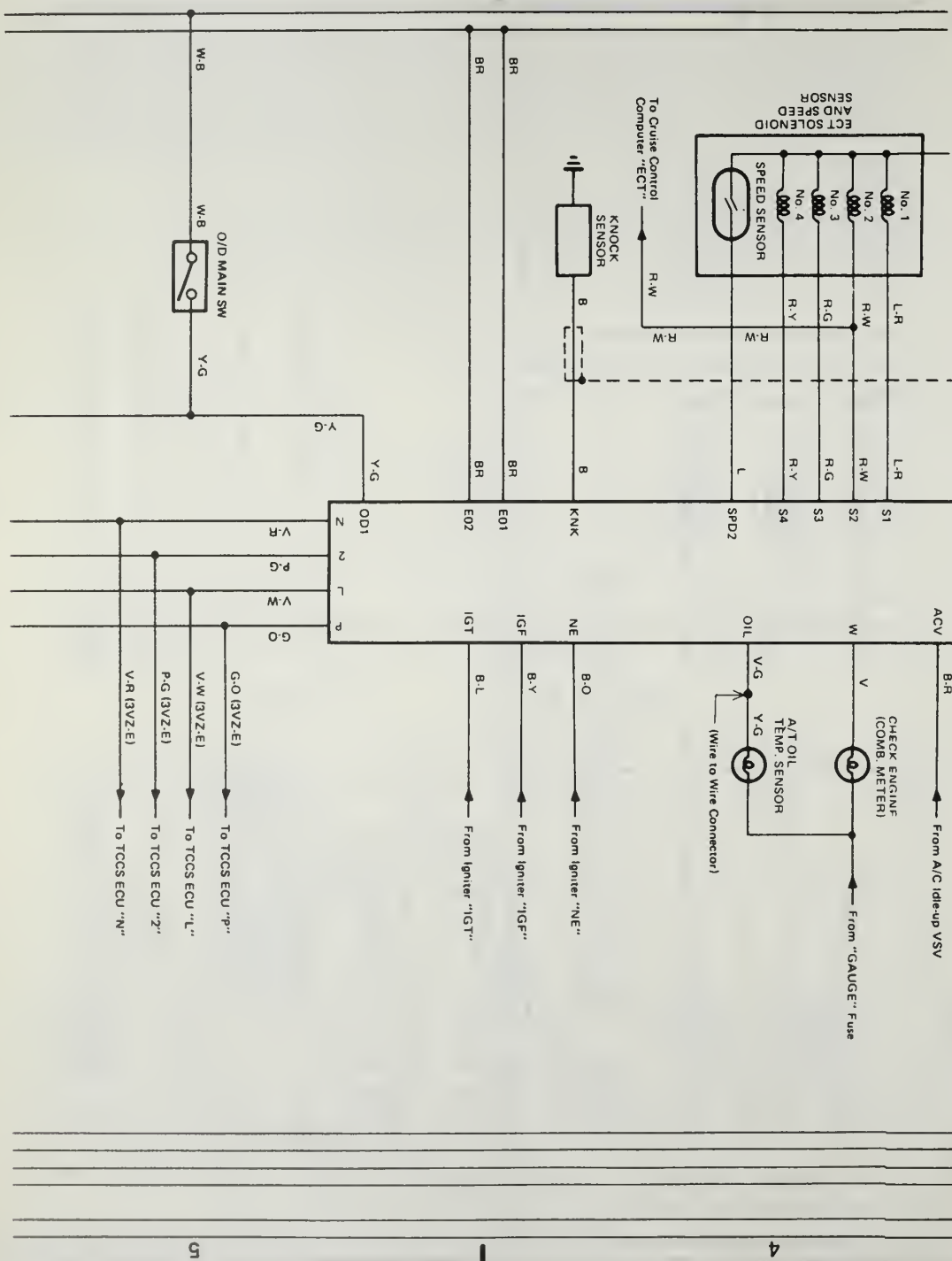


Wiring diagram — 1989 truck



Wiring diagram — 1989 truck

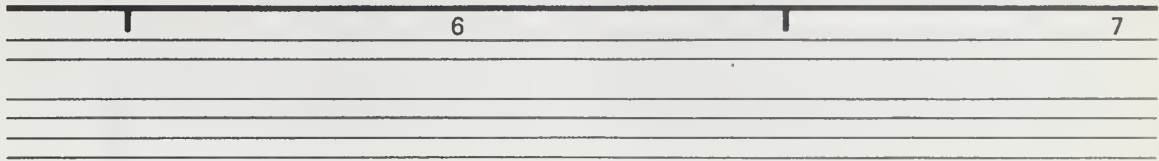
6



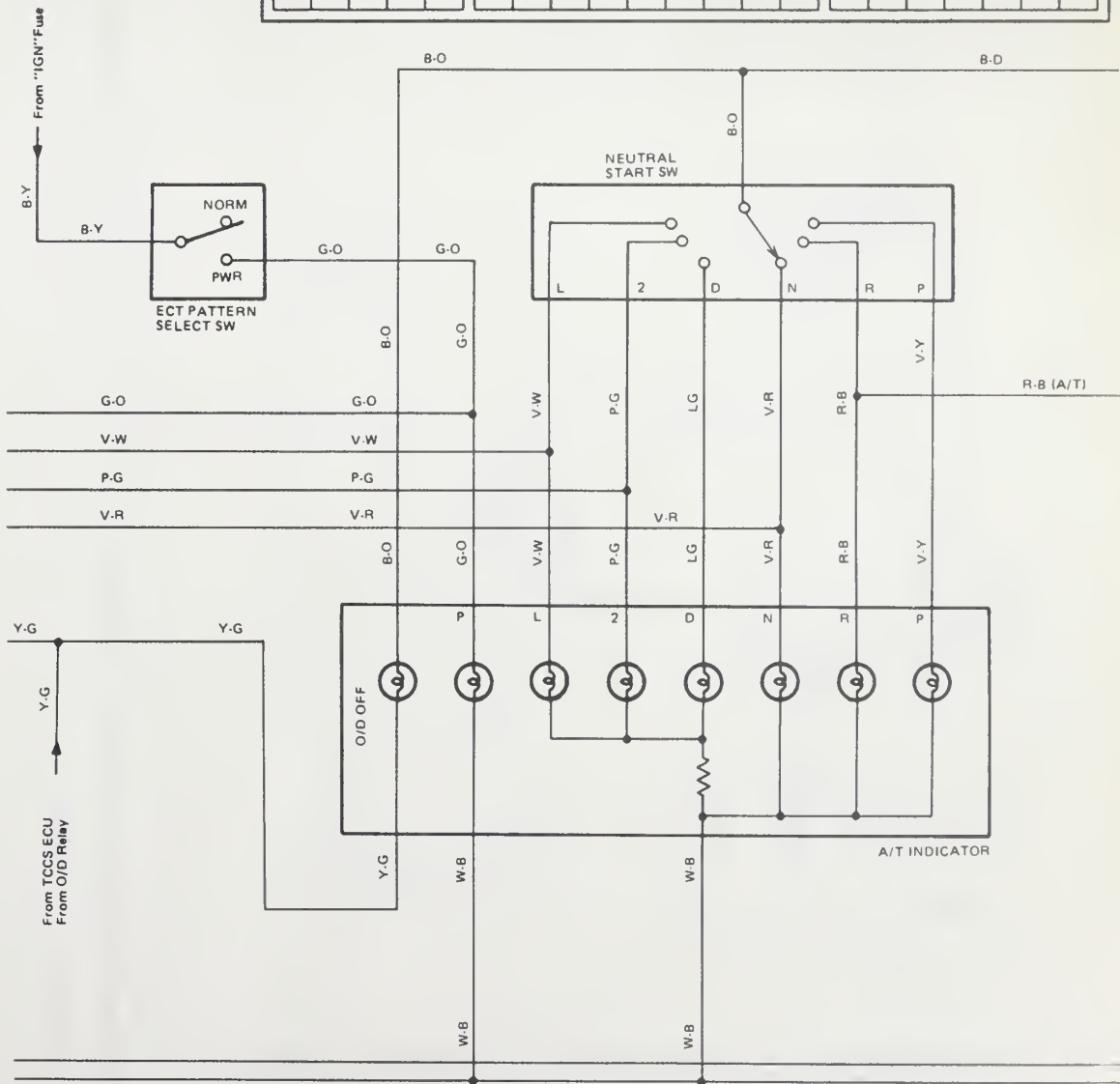
Wiring diagram – 1989 truck



Automatic Transmission Indicator



E01	#10	STA	STJ	NSW	FPU	W	T	IDL	IGF	OX2	THG	KNK	NE	HT2	VC	VS	THA	BATT	B1
E02	#20	IGT	E1	VF	ACV	AS	EGR	HT1	E2	OX1	VCC	VTA	THW		E21	4WD	SPD	STP	B



Wiring diagram – 1989 truck

8

- A
- B
- D
- E
- F
- G

B-Q

B-O

B-O

B.O

BACK-UP
LIGHT SW

R-W (3VZ-E, 22R)
R-B (22R-F)

A-8

R-6

(Column Type)

R.W. (3VZ-E, 22R)
B.B. (22R-E)

R-Y

R-

R-W (3VZ-E, 22R)
R-B (22R-F)

R-W (3VZ-E, 22R)
R-B (22R-E)

Z.E., 22R)

LH

RH

W-E

W

W.

W

W-E

W.

BACK-UP LIGHT RELAY

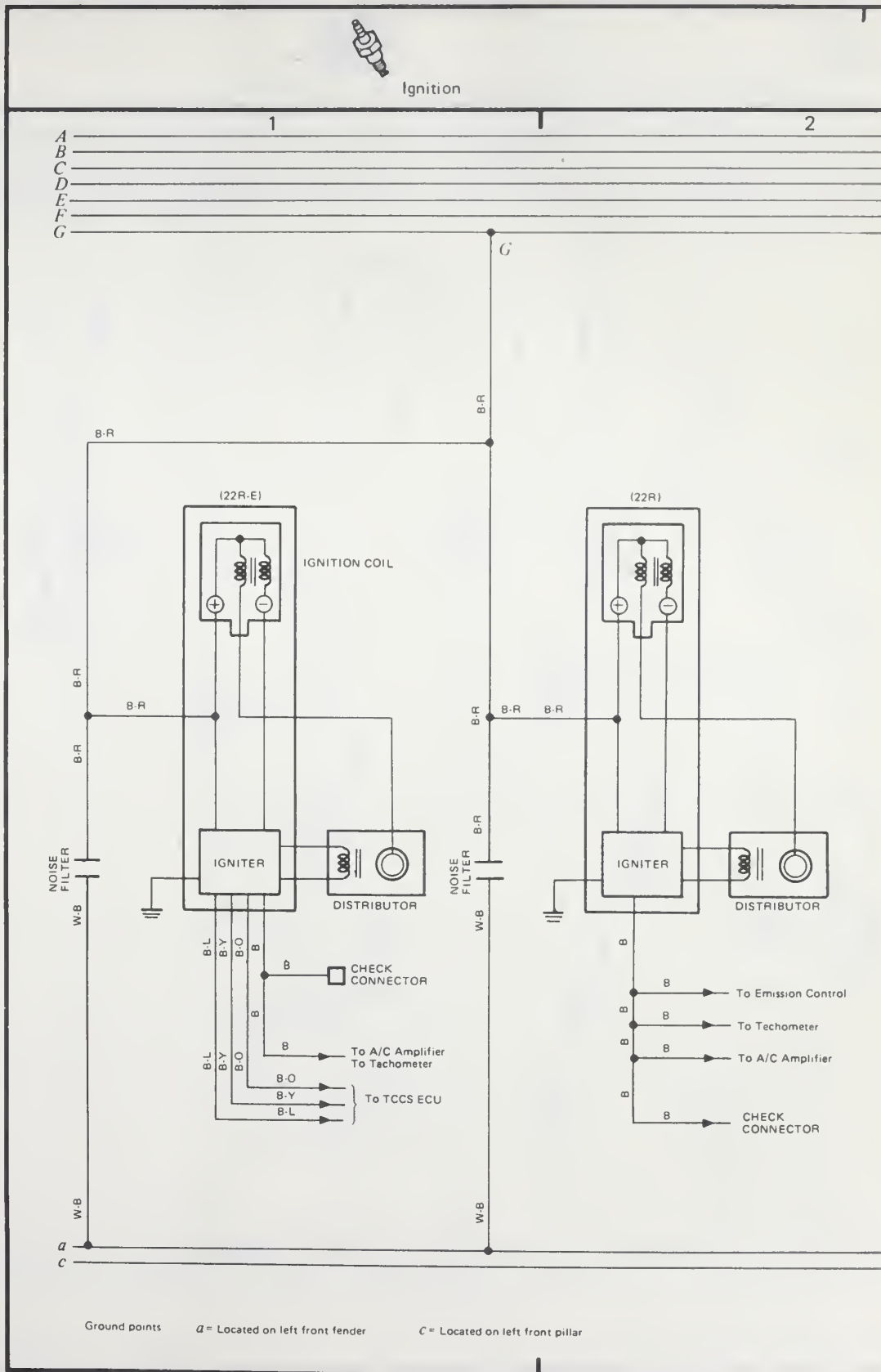
3

1

W-B

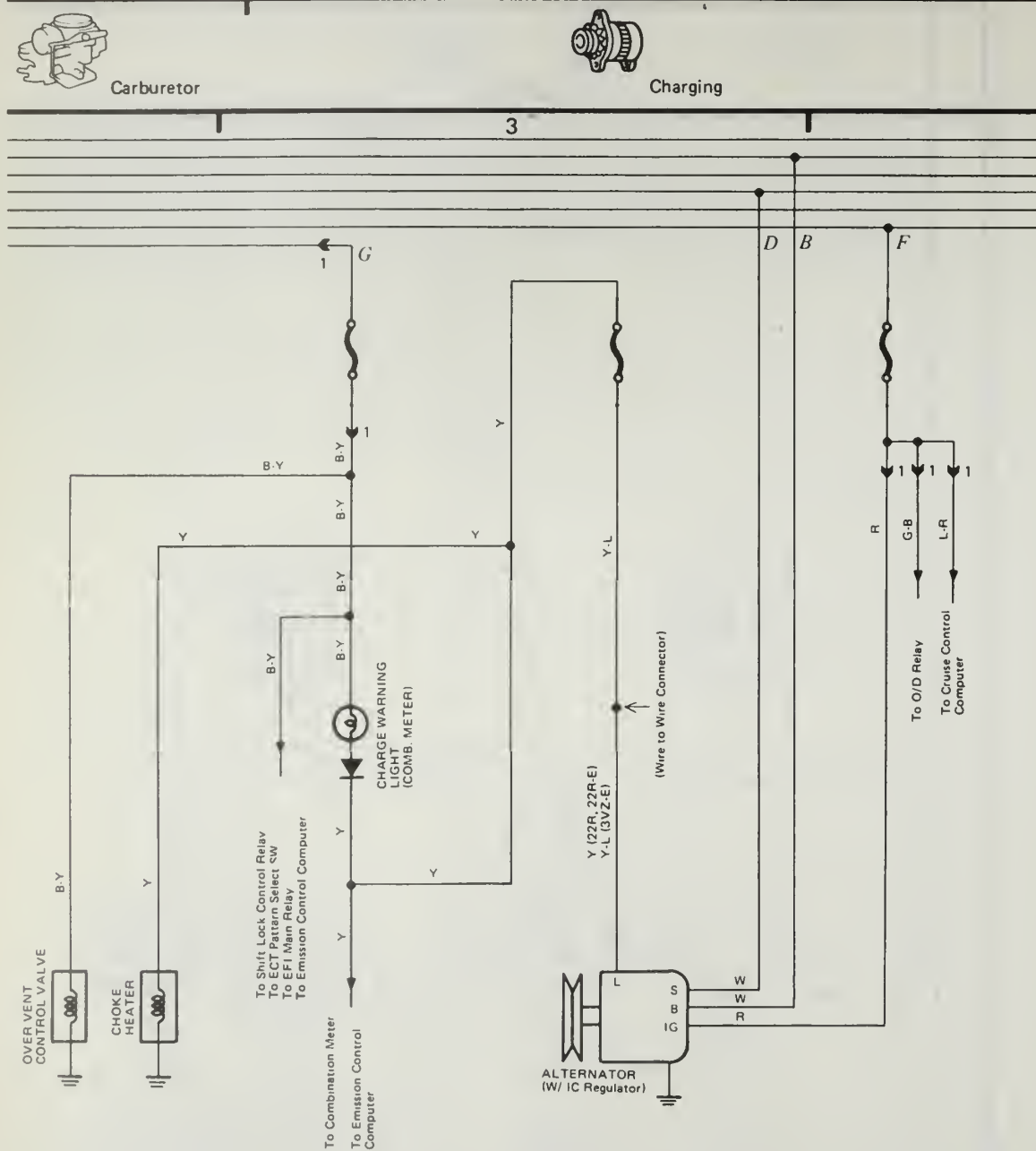
$$-b$$

Wiring diagram — 1989 truck



Wiring diagram — 1989 truck

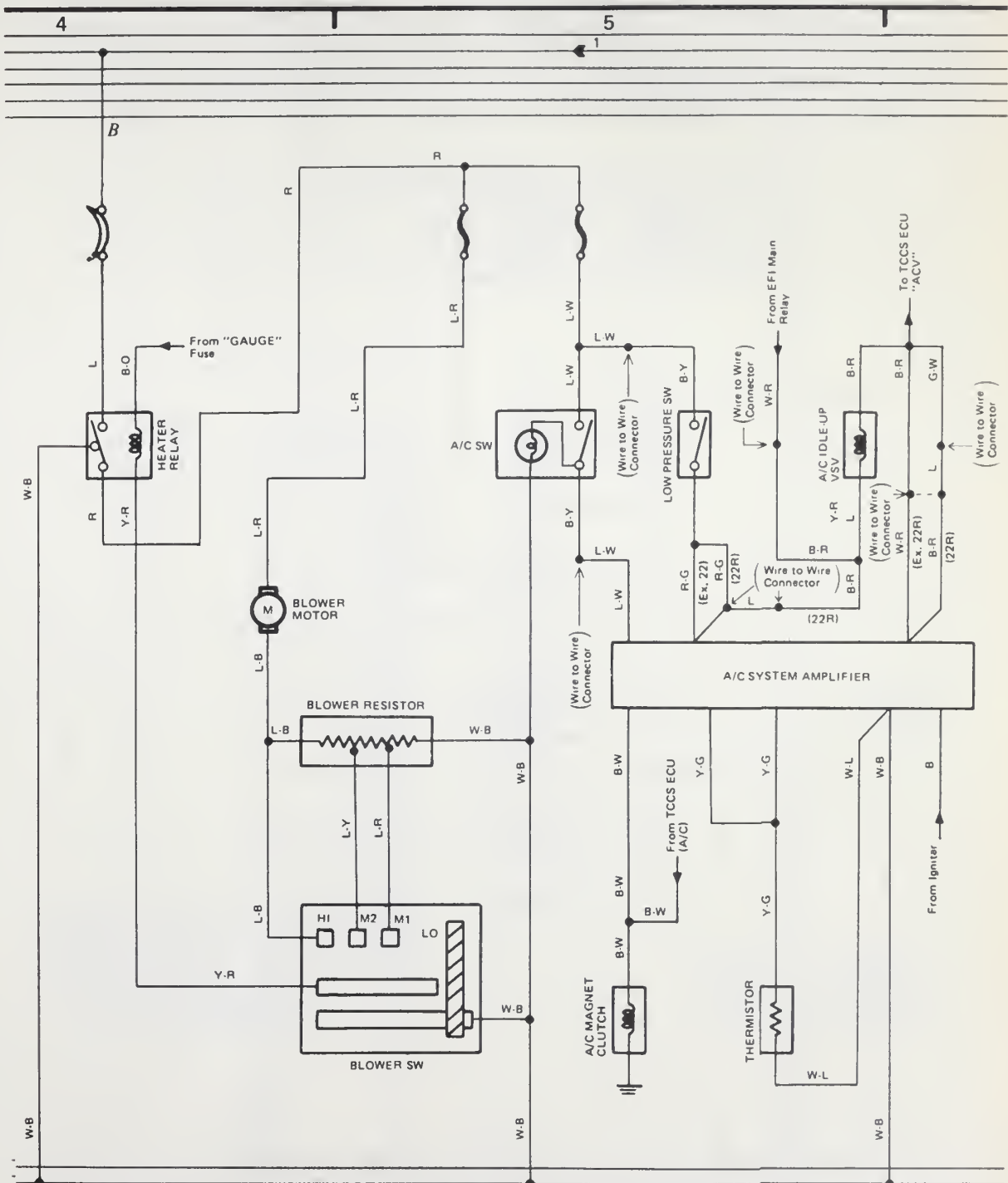
6 CHASSIS ELECTRICAL



Wiring diagram — 1989 truck



Air Conditioner, Cooler and Heater



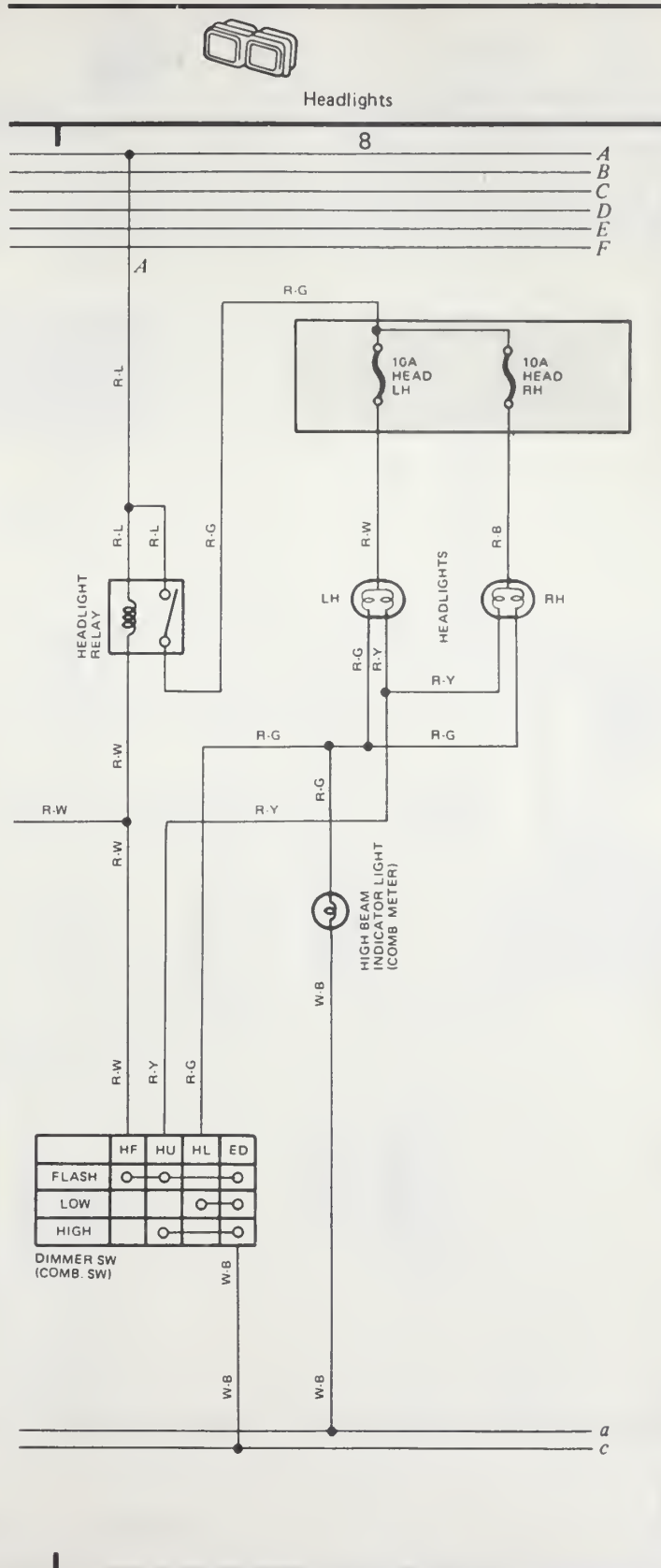
Wiring diagram — 1989 truck

The diagram illustrates the electrical wiring for a vehicle, featuring a central 15A tail light fuse. The wiring is organized into several sections:

- Top Section:** A 15A TAIL fuse is connected to a central point. From this point, wires lead to a Light Reminder Relay (G), a Clock (Digital) (G), and a Tail Light Relay (R-B).
- Central Cluster:** A central cluster of components is connected to a common ground (G). The components include:
 - HEATER BLOWER SW (R-B)
 - A/C SW (R-B)
 - RADIO (R-B)
 - HAZARD SW (R-B)
 - CIGARETTE LIGHTER (R-B)
 - COMBINATION METER (R-B)
 - REAR DEFOGGER SW (R-B)
 - LICENCE PLATE LIGHT LH (W-B)
 - LICENCE PLATE LIGHT RH (W-B)
 - TAILLIGHT LH (W-B)
 - TAILLIGHT RH (W-B)
 - CLEARANCE LIGHT LH (W-B)
 - CLEARANCE LIGHT RH (W-B)
 - REAR SIDE MARKER LH (W-B)
 - REAR SIDE MARKER RH (W-B)
- Left Section:** A GLOVE BOX LIGHT SW is connected to a GLOVE BOX LIGHT. A RHEOSTAT (A/T, M/T 4 x 4) is connected to a RHEOSTAT (M/T 4 x 2).
- Right Section:** A LIGHT CONTROL SW (COMB. SW) is shown with positions for OFF, TAIL, and HEAD. It is connected to a TAIL LIGHT RELAY and a HEAD LIGHT RELAY.

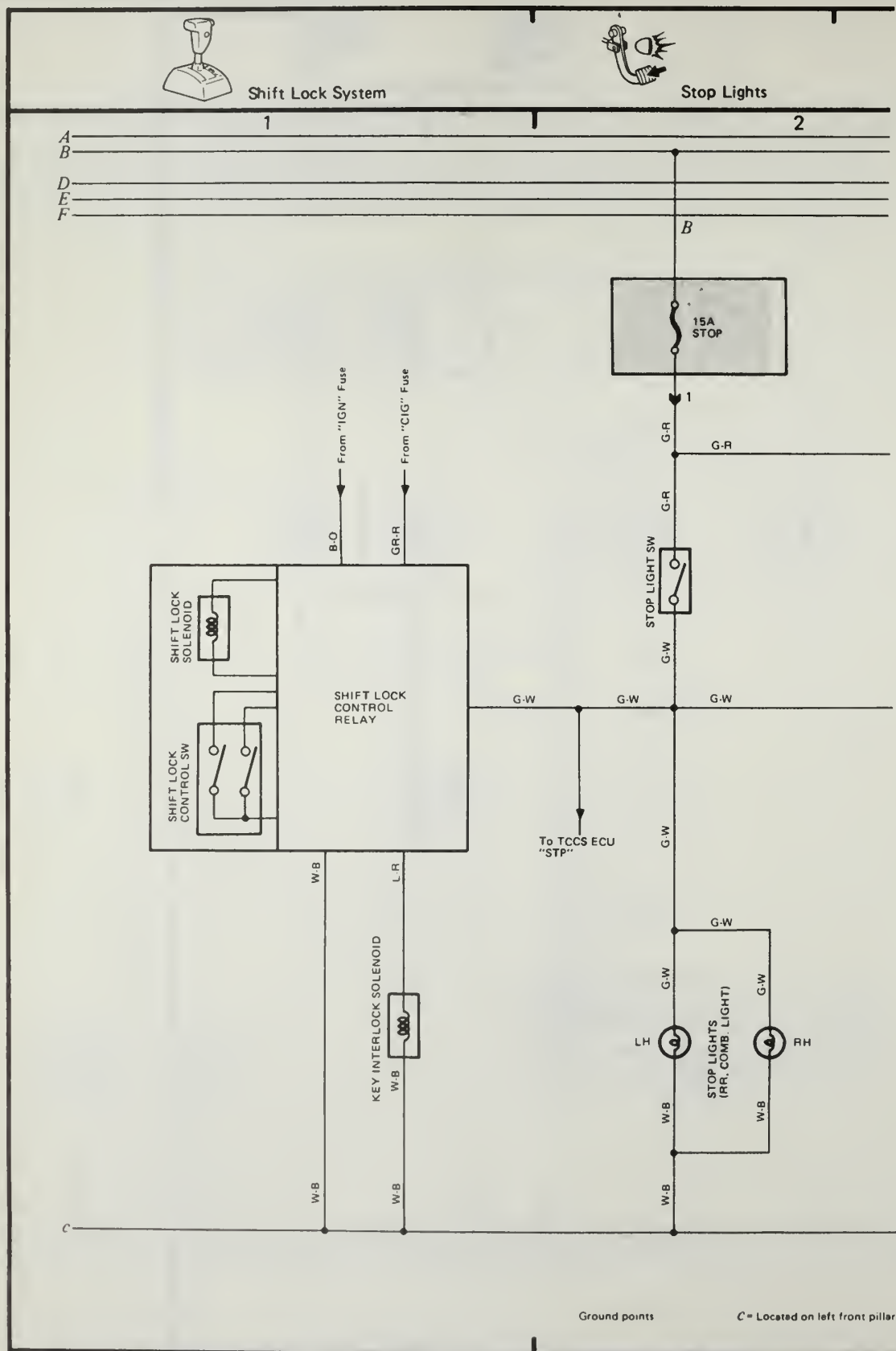
Wire colors and terminal labels are used throughout the diagram to identify specific wires and connections.

6-58



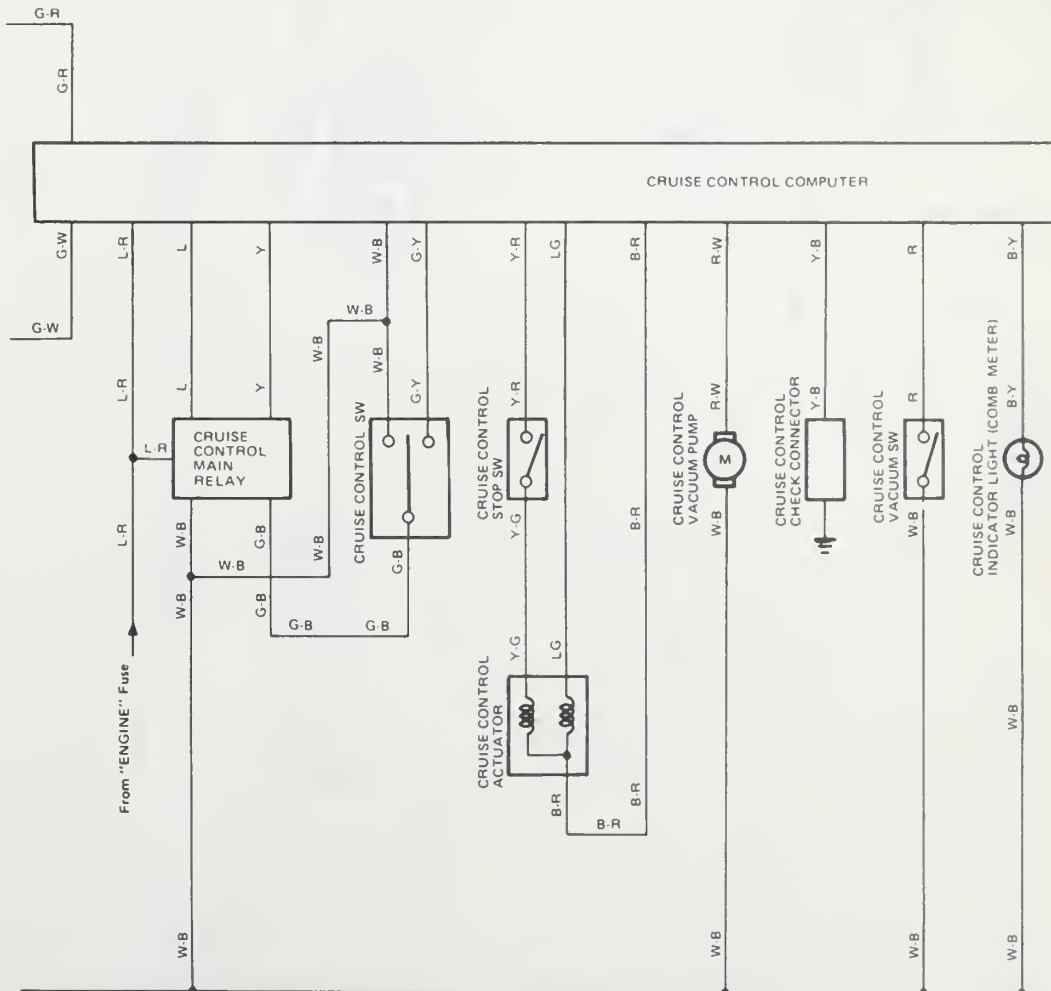
Wiring diagram — 1989 truck

6 CHASSIS ELECTRICAL



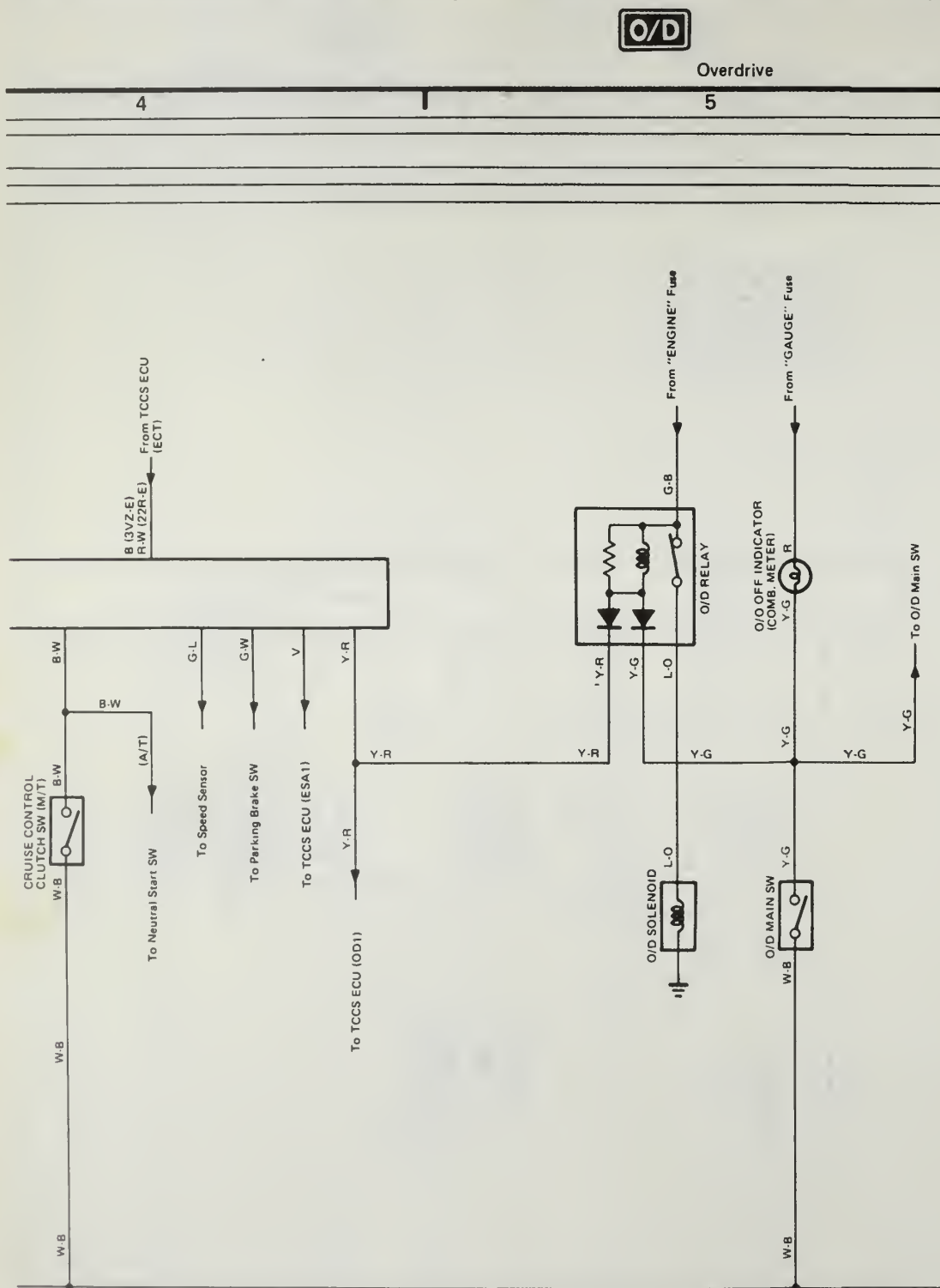
Wiring diagram — 1989 truck

3

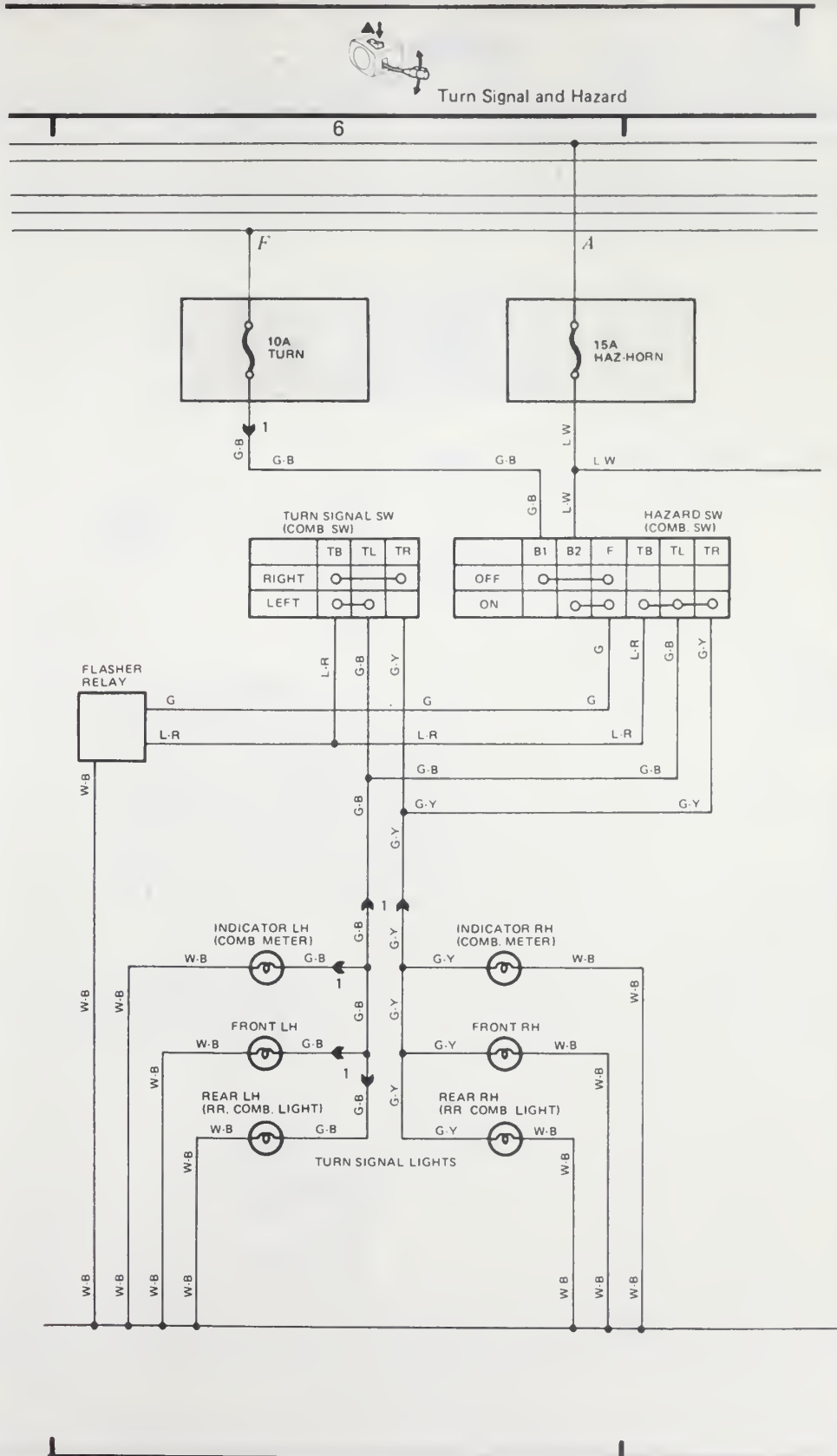


6-61

6 CHASSIS ELECTRICAL

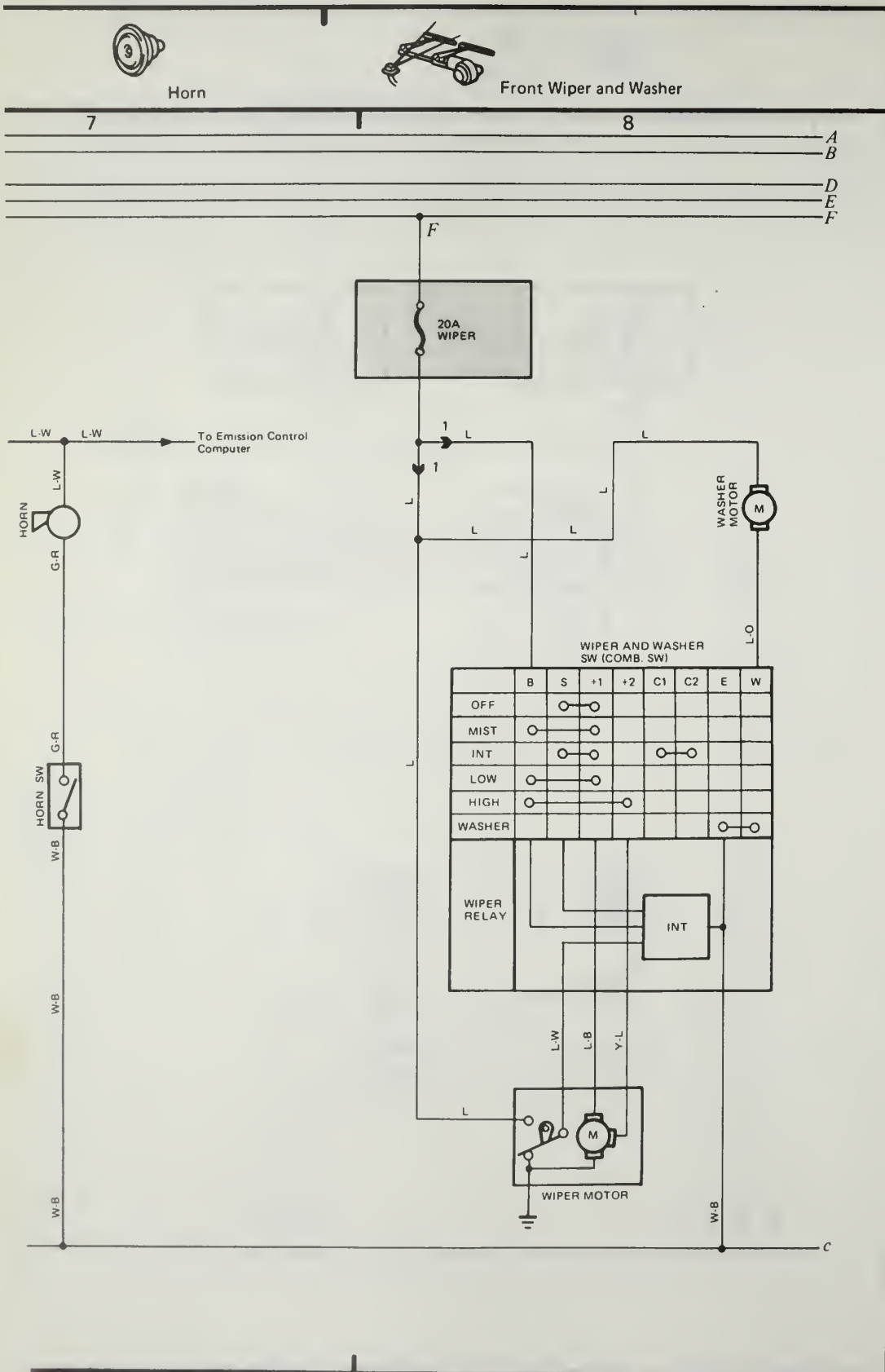


Wiring diagram — 1989 truck



Wiring diagram — 1989 truck

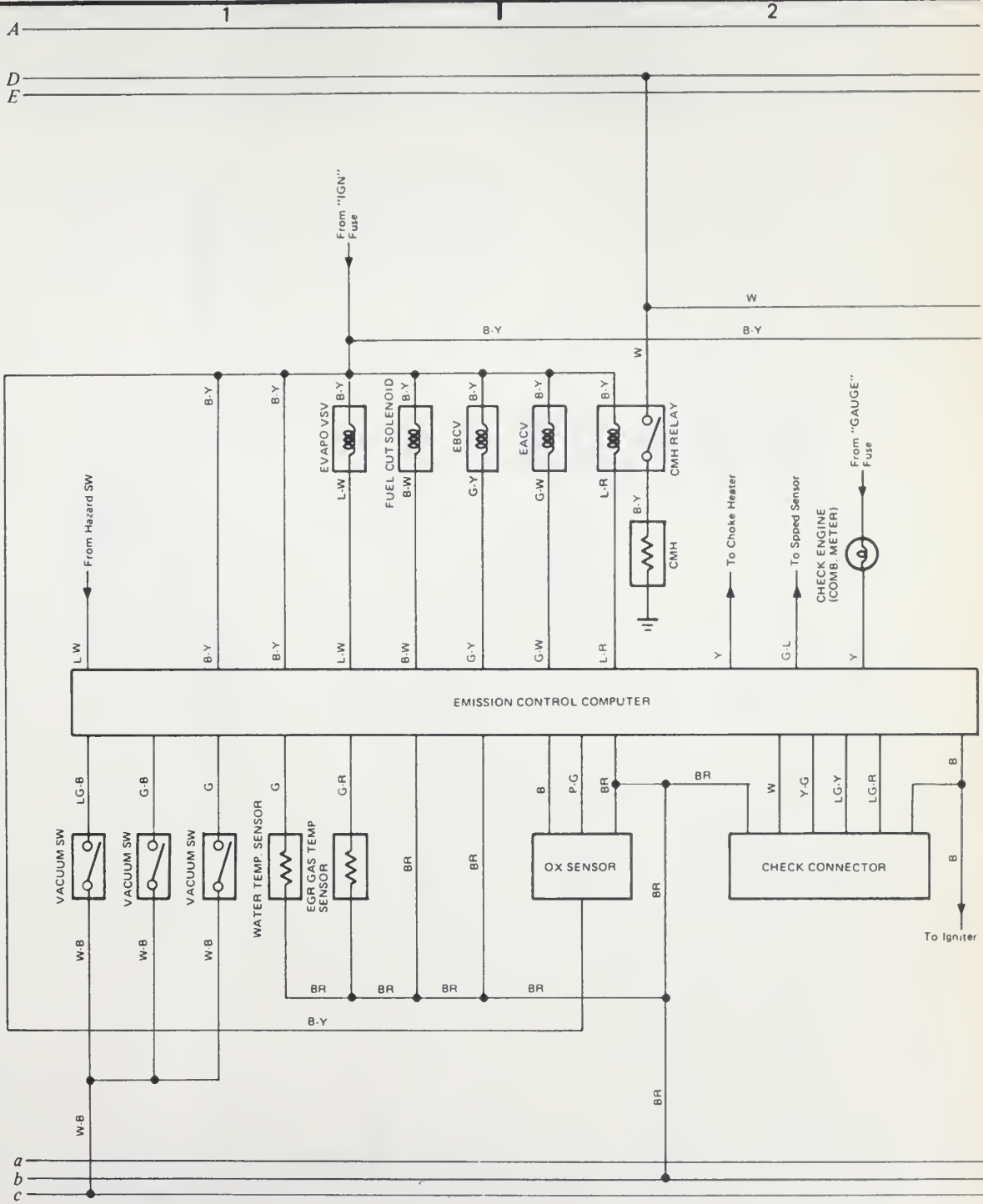
6 CHASSIS ELECTRICAL



Wiring diagram – 1989 truck



Emission Control



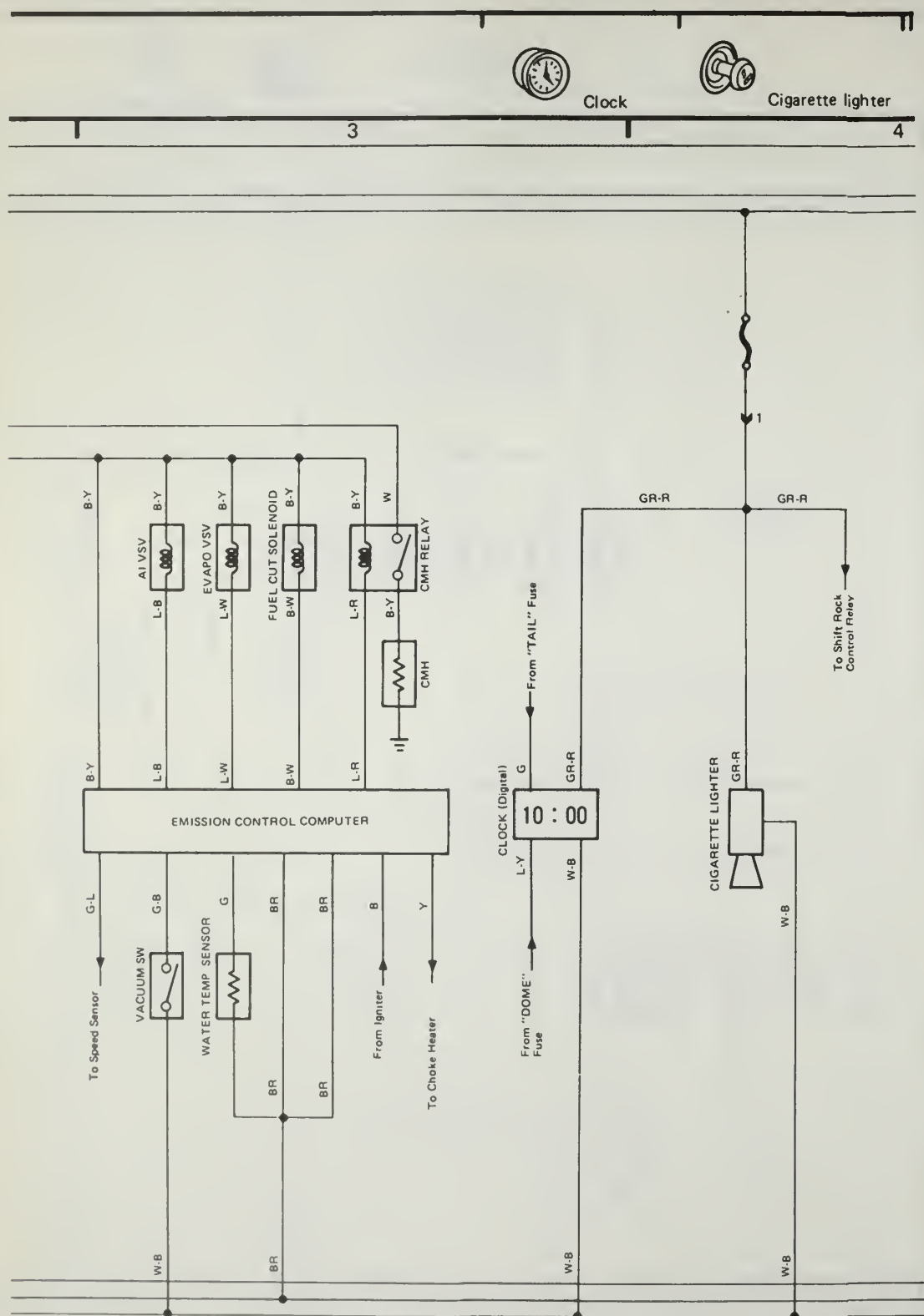
Ground points

a = Located on left front fender

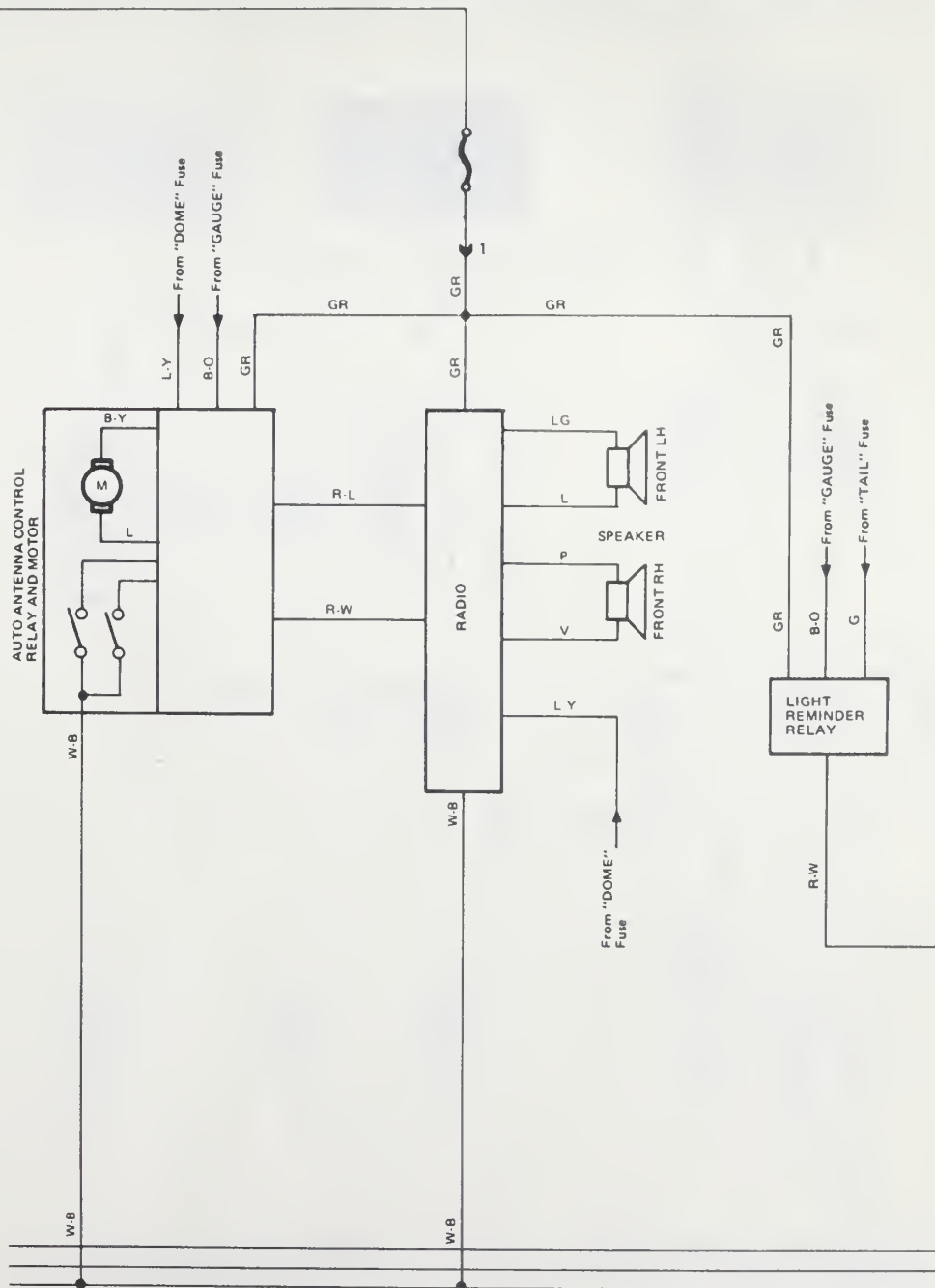
b = Located on engine block

Wiring diagram — 1989 truck

6 CHASSIS ELECTRICAL

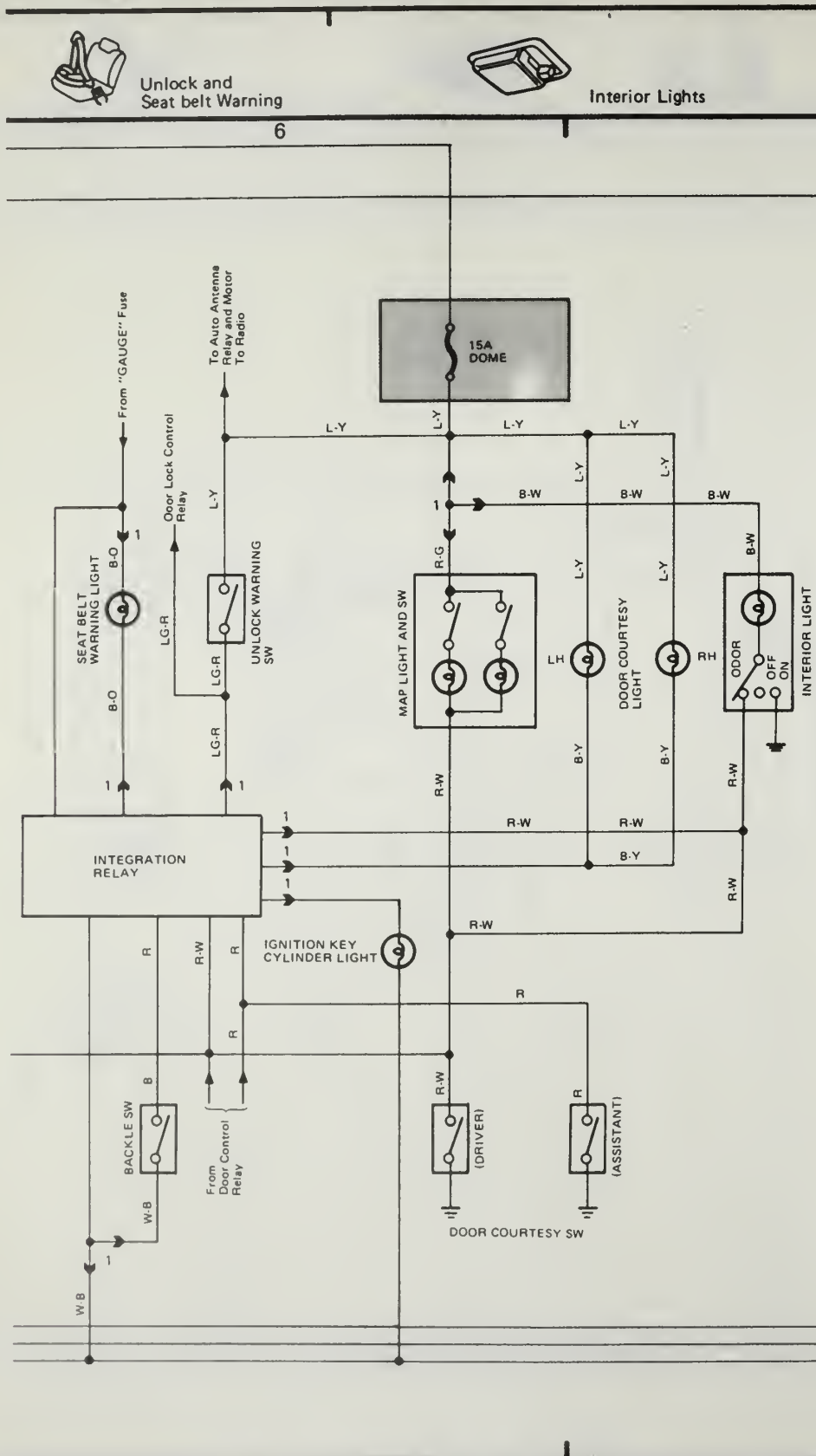


Wiring diagram — 1989 truck

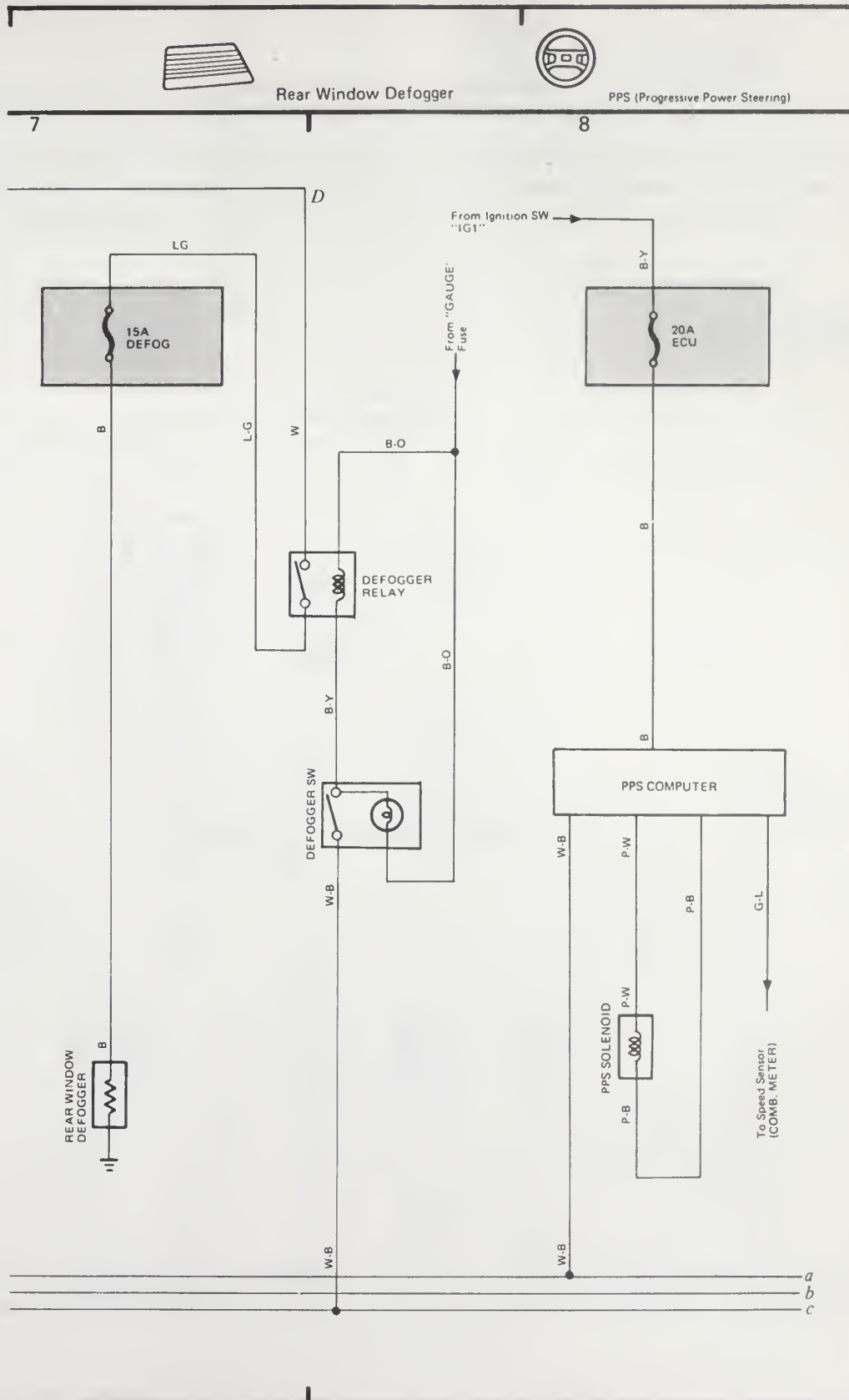


Wiring diagram — 1989 truck

6 CHASSIS ELECTRICAL

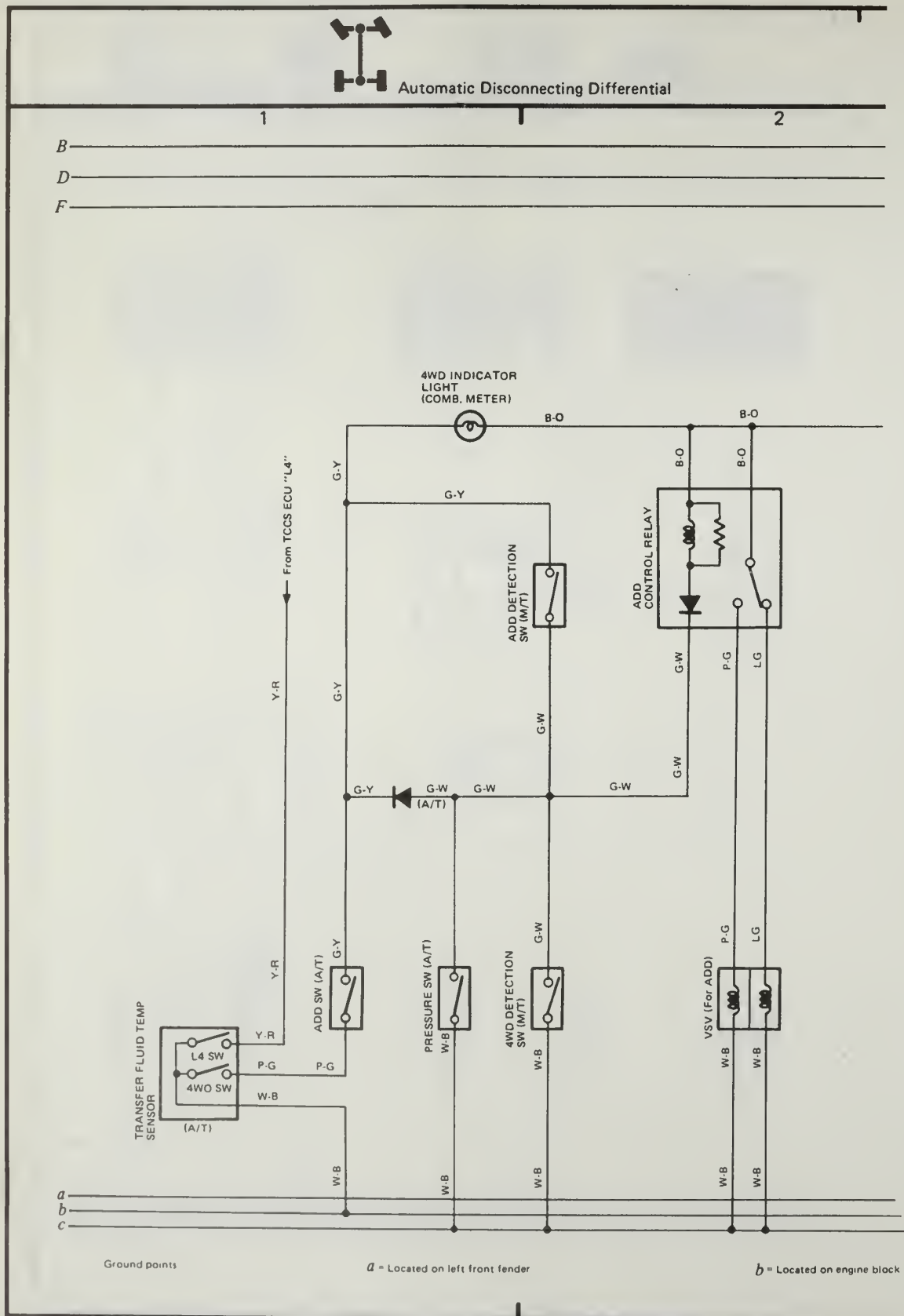


Wiring diagram — 1989 truck



Wiring diagram — 1989 truck

6 CHASSIS ELECTRICAL

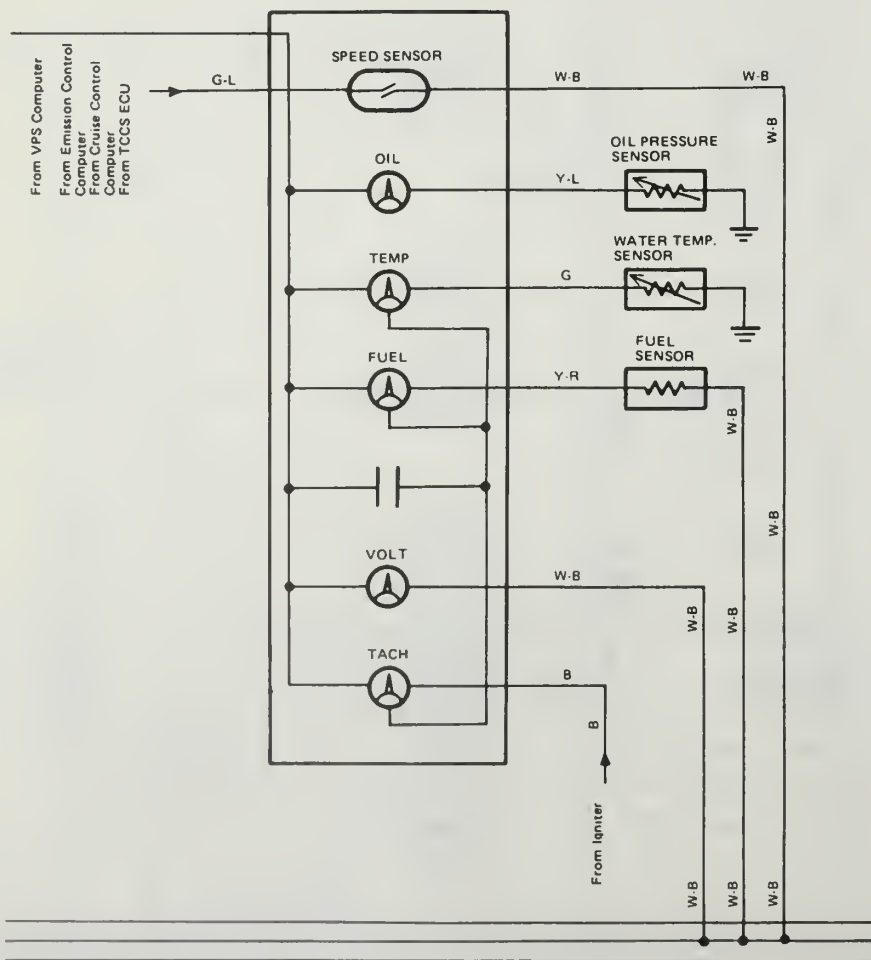
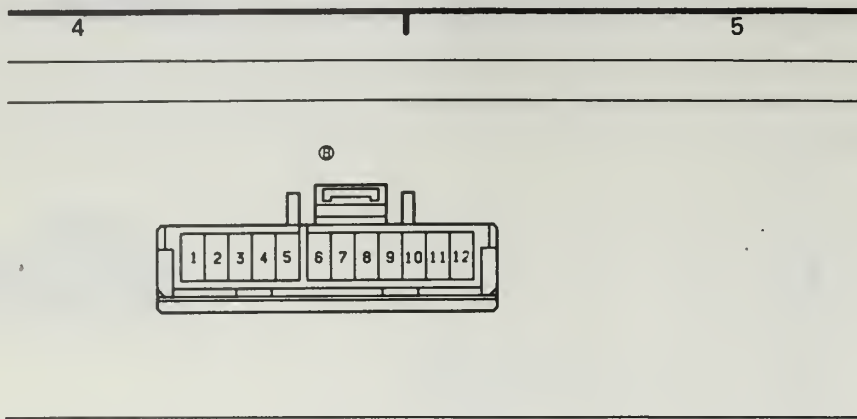


Wiring diagram — 1989 truck



Wiring diagram — 1989 truck

6 CHASSIS ELECTRICAL

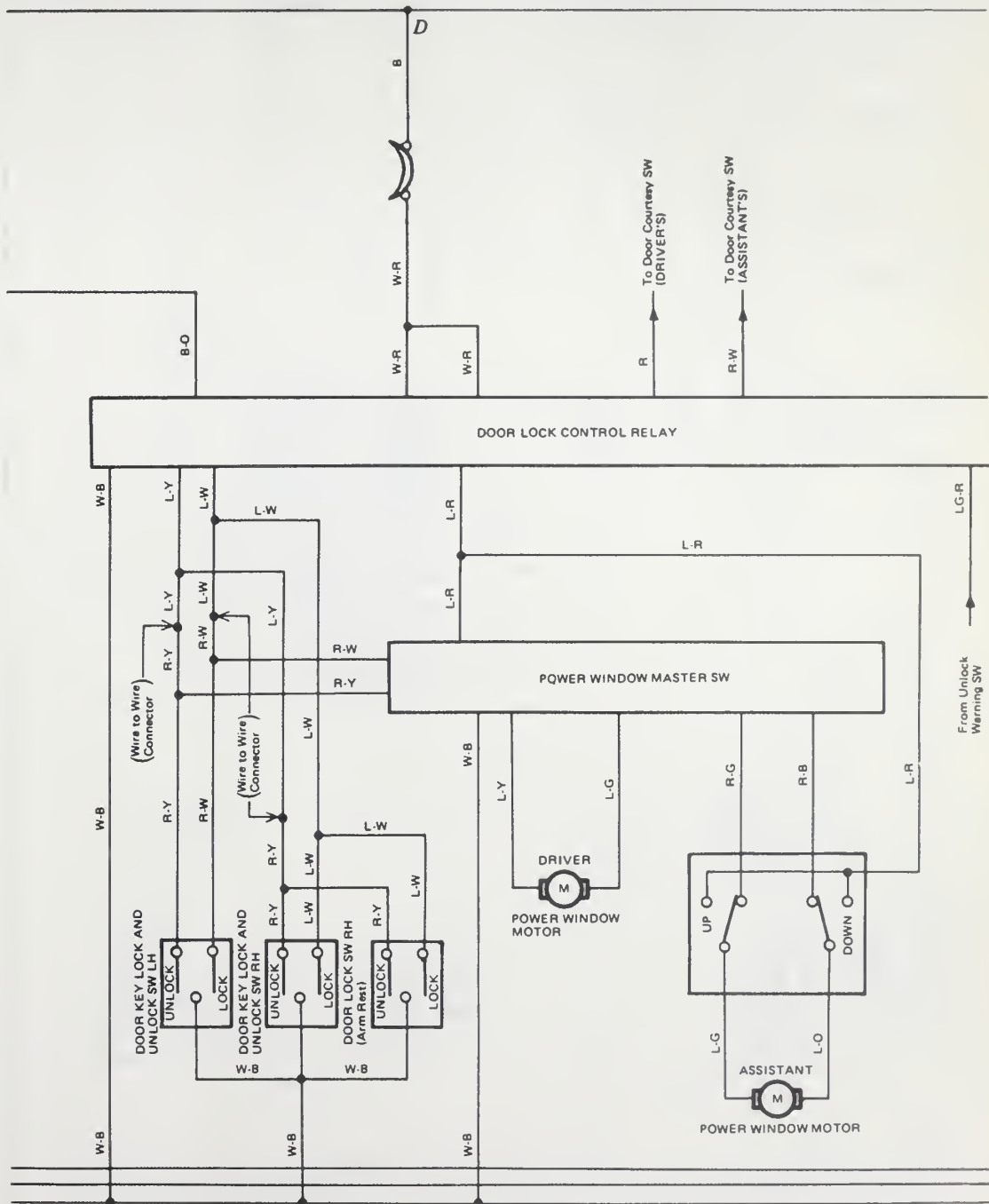


Wiring diagram – 1989 truck



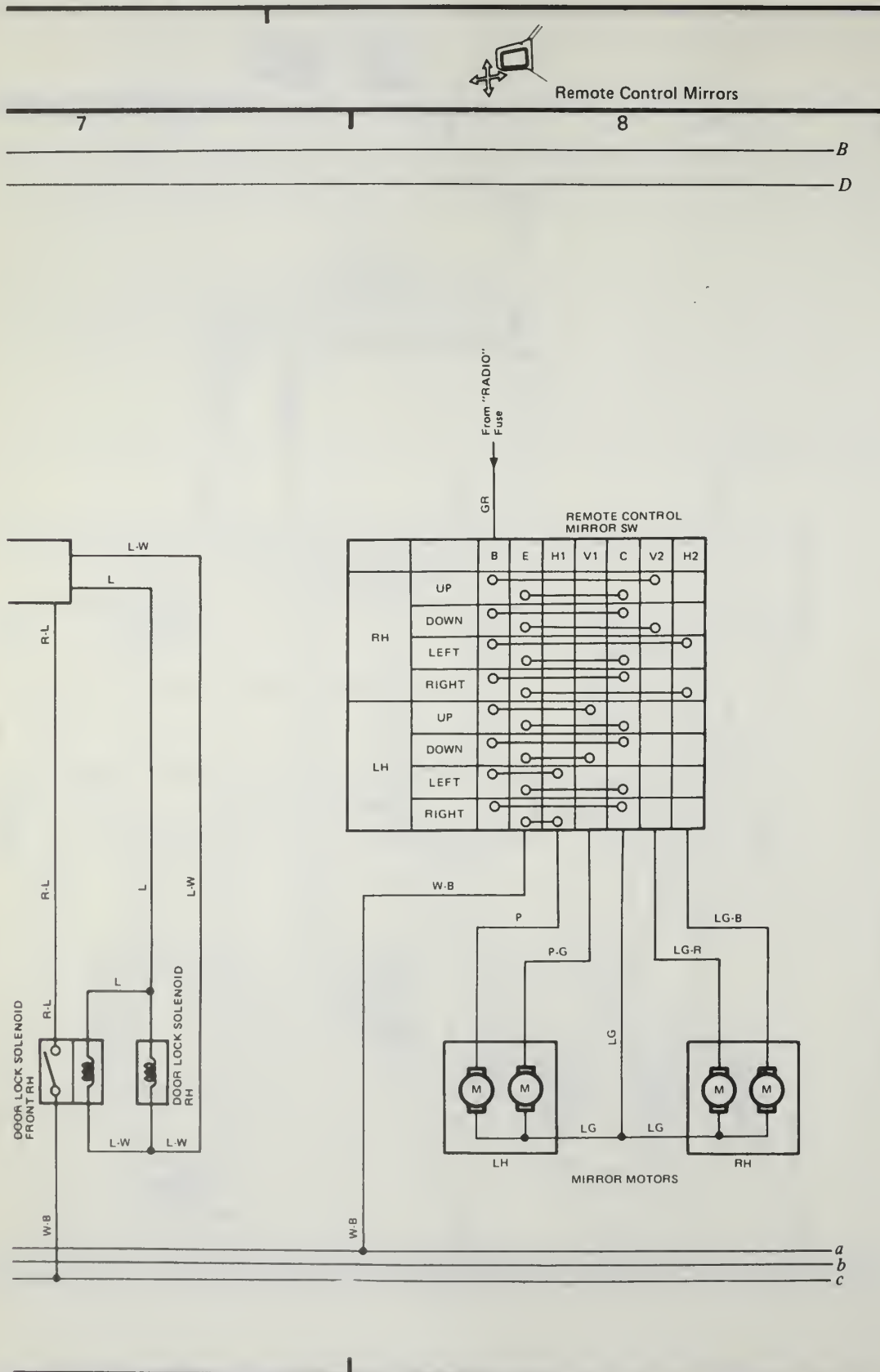
Power Windows and Door Locks

6



Wiring diagram — 1989 truck

6 CHASSIS ELECTRICAL



Wiring diagram — 1989 truck

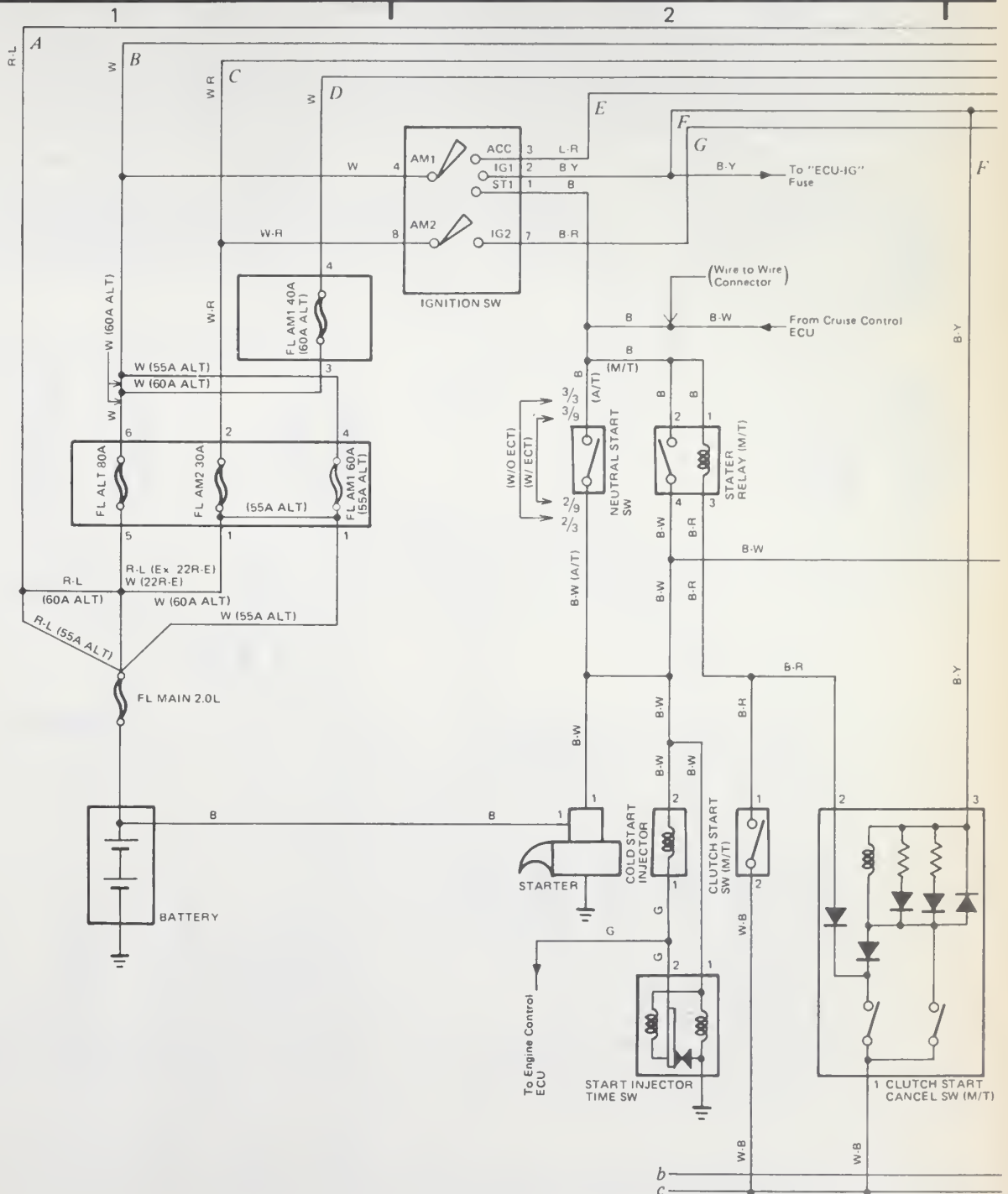
CHASSIS ELECTRICAL 6



Power Source

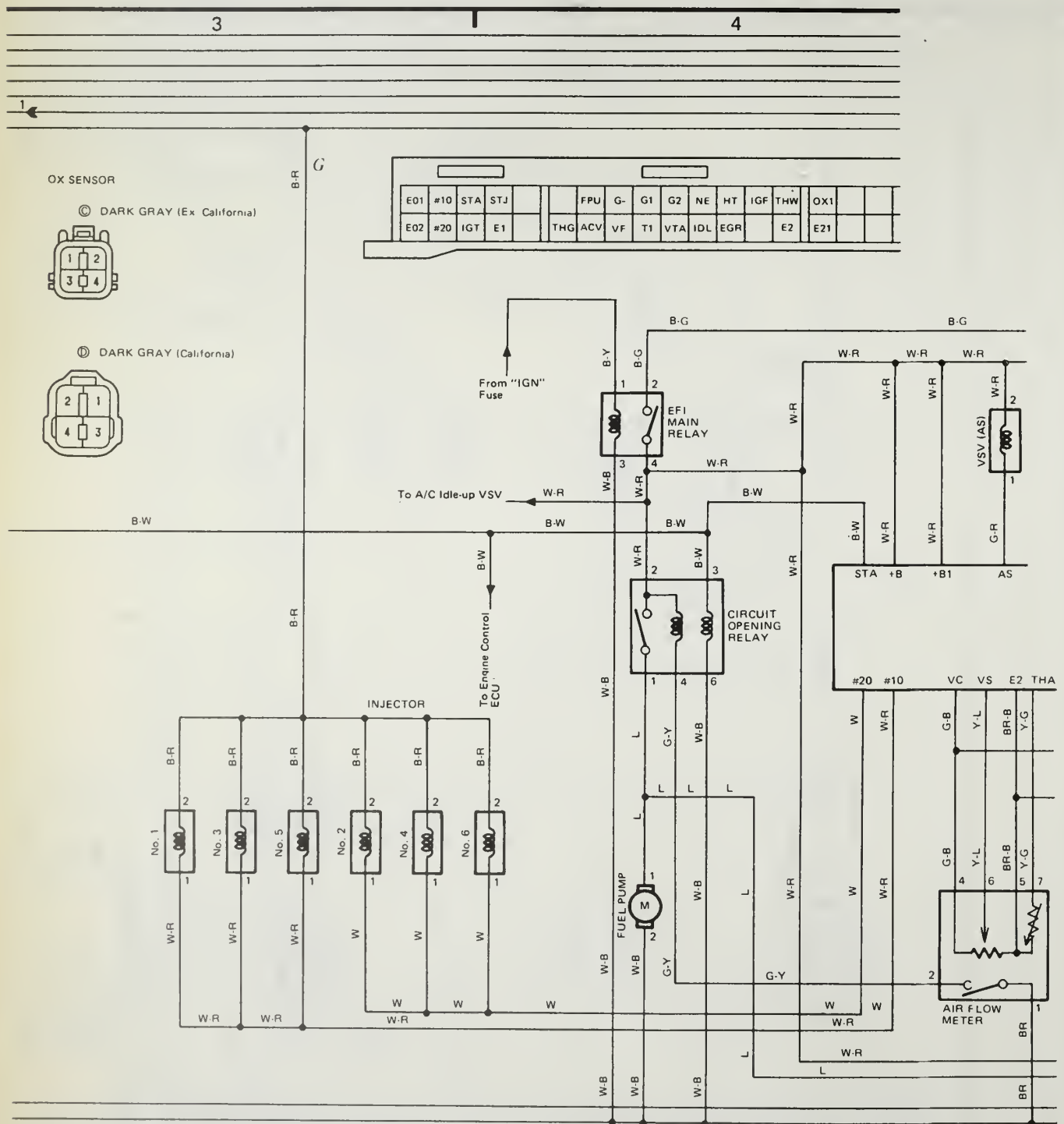


Starting



Wiring diagram — 1990 truck

6 CHASSIS ELECTRICAL



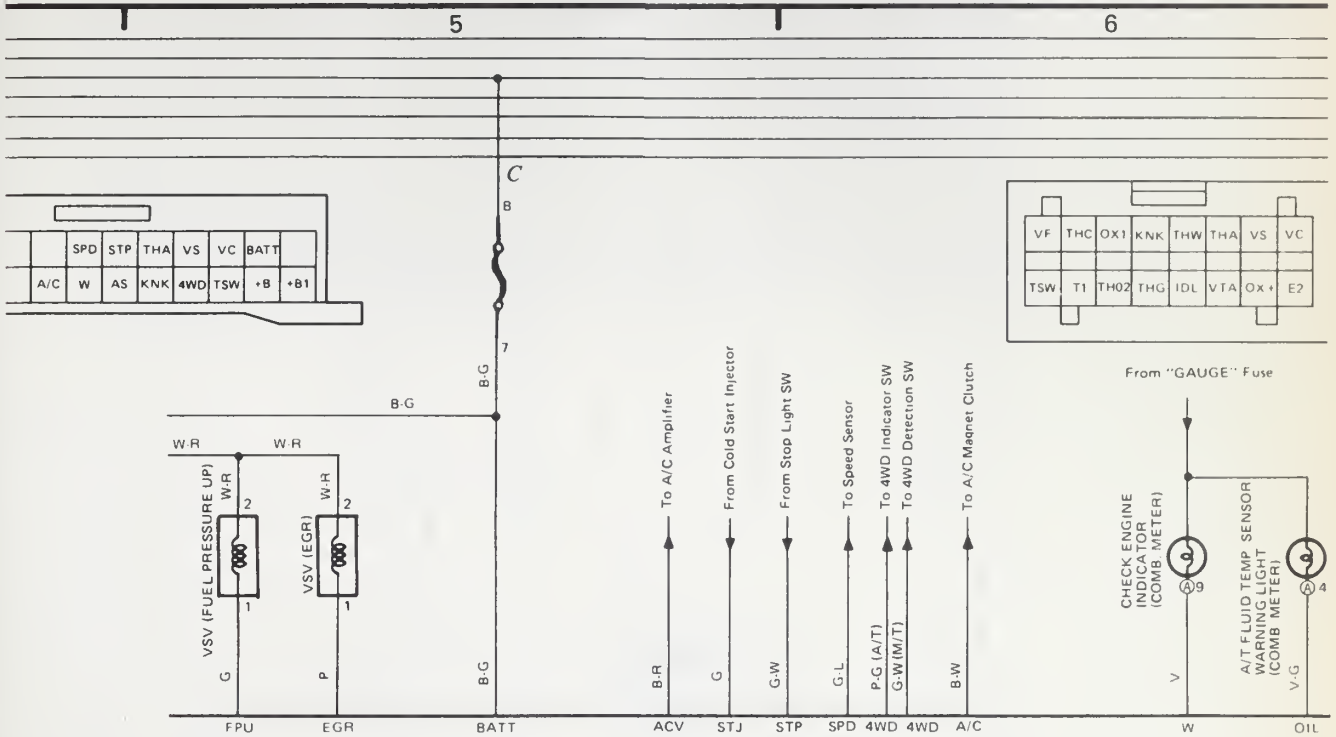
C = Located on left front pillar

Wiring diagram — 1990 truck

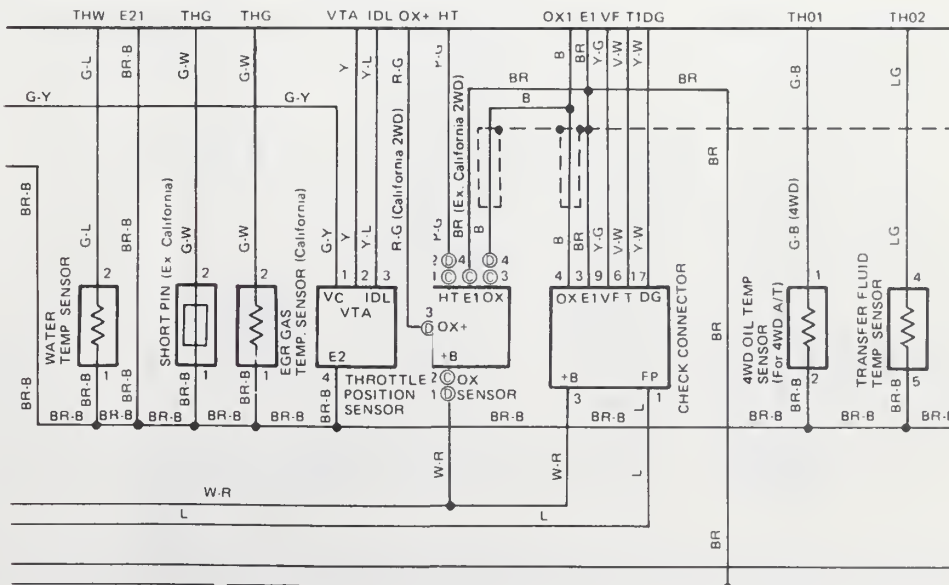


ECT

Engine Control and ECT (3VZ-E)

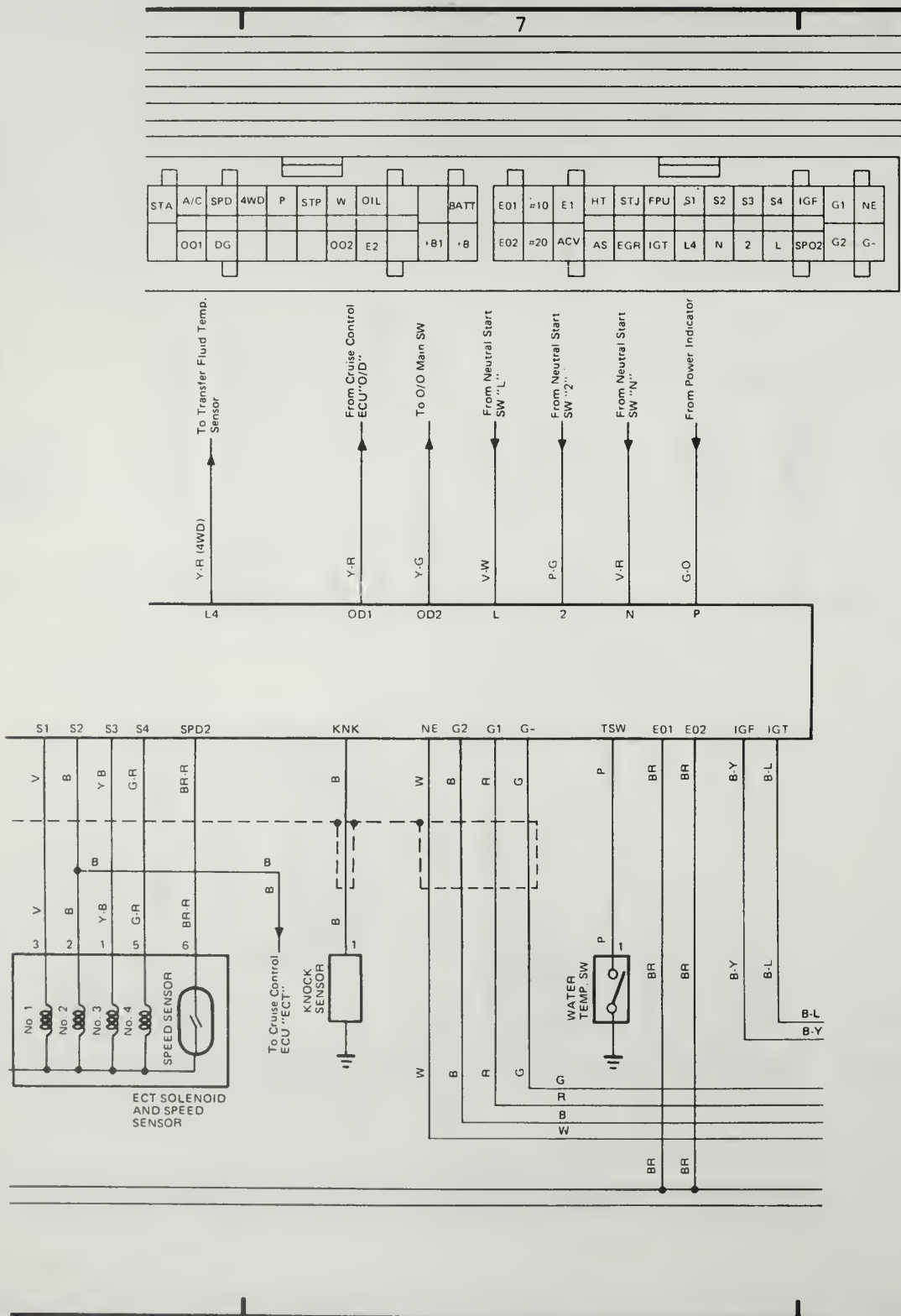


ENGINE and ECT ECU

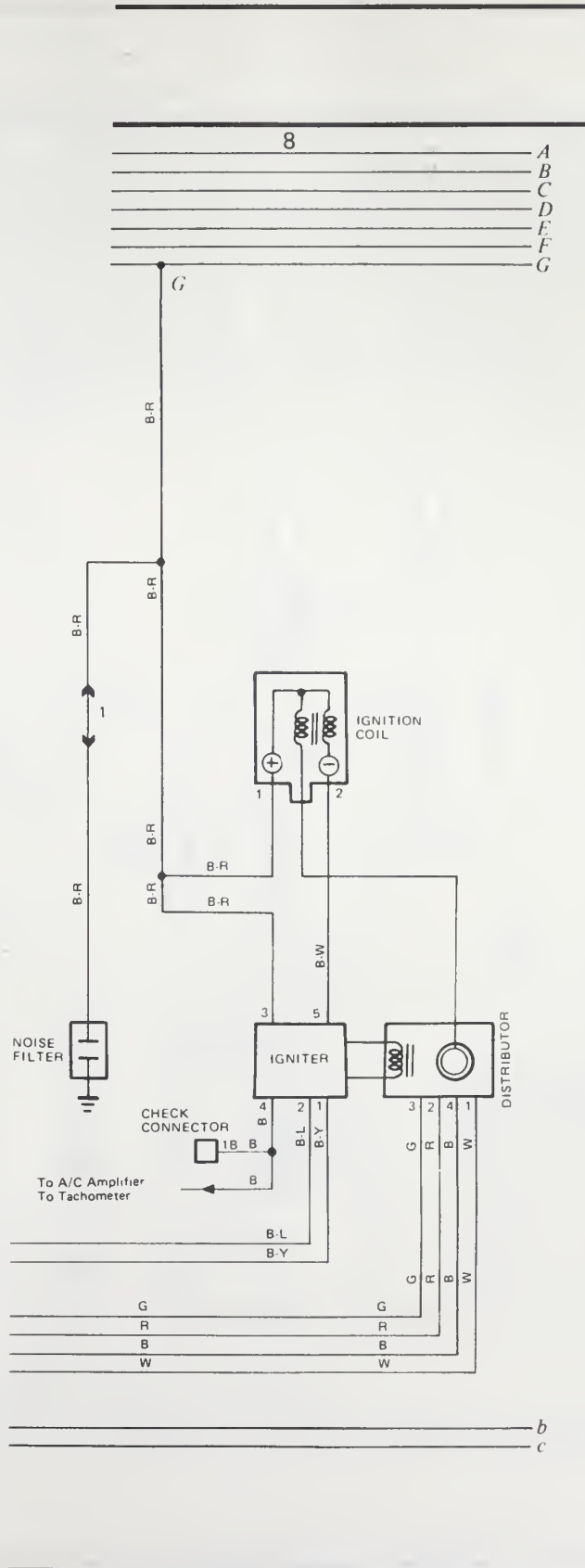


Wiring diagram -- 1990 truck

6 CHASSIS ELECTRICAL

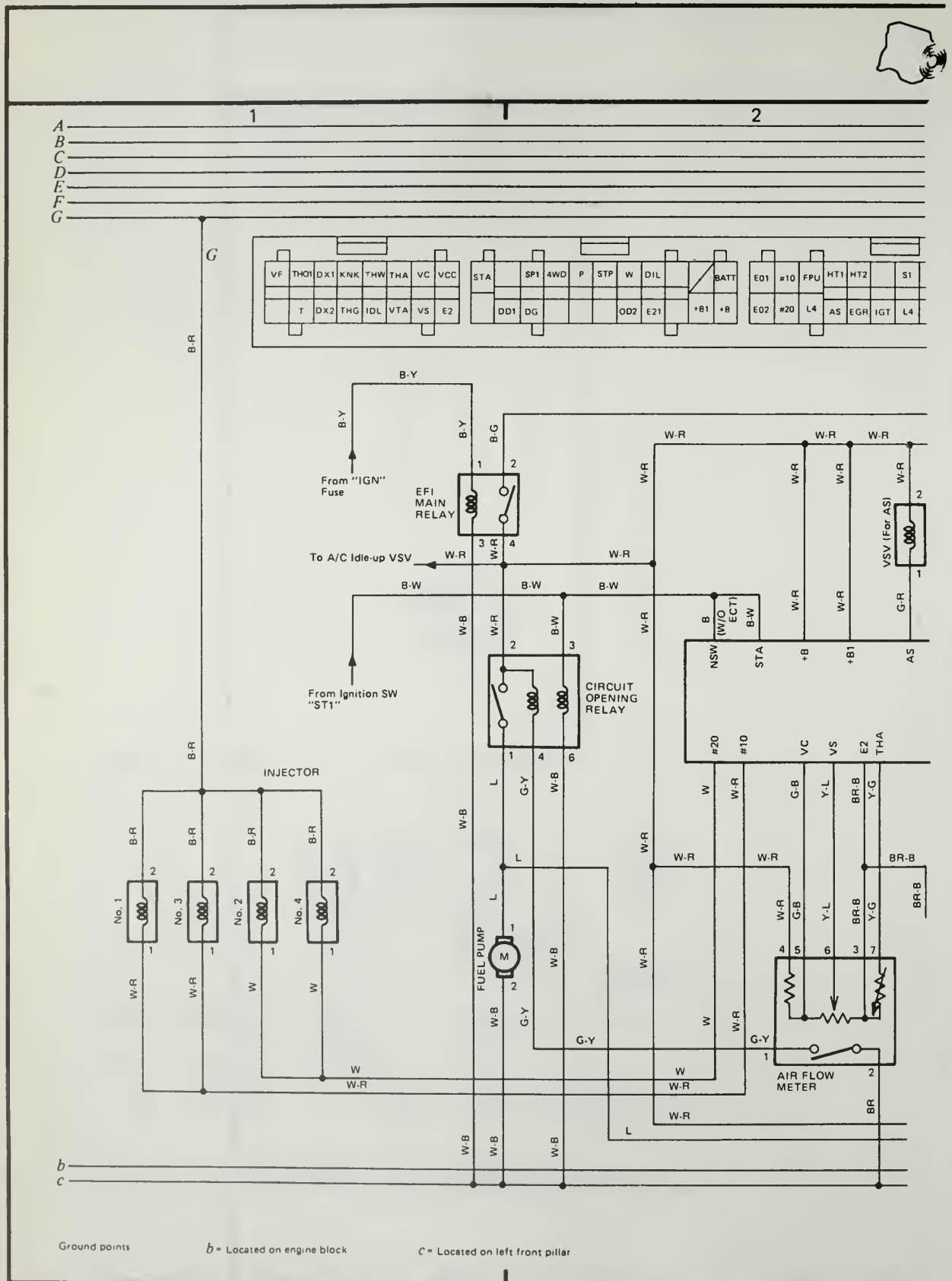


Wiring diagram - 1990 truck



Wiring diagram — 1990 truck

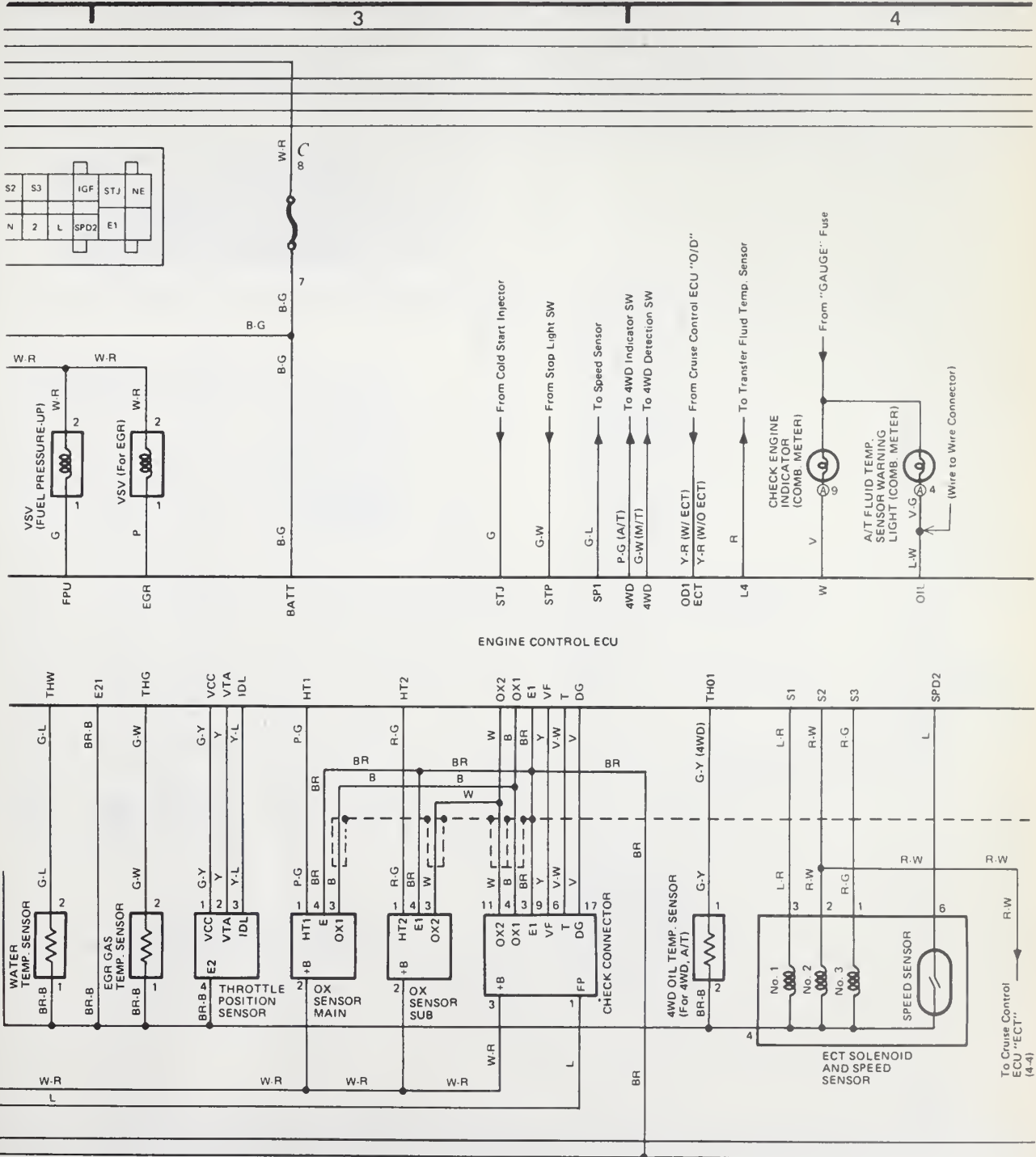
6 CHASSIS ELECTRICAL



Wiring diagram — 1990 truck

ECT

Engine Control and ECT (22R-E)

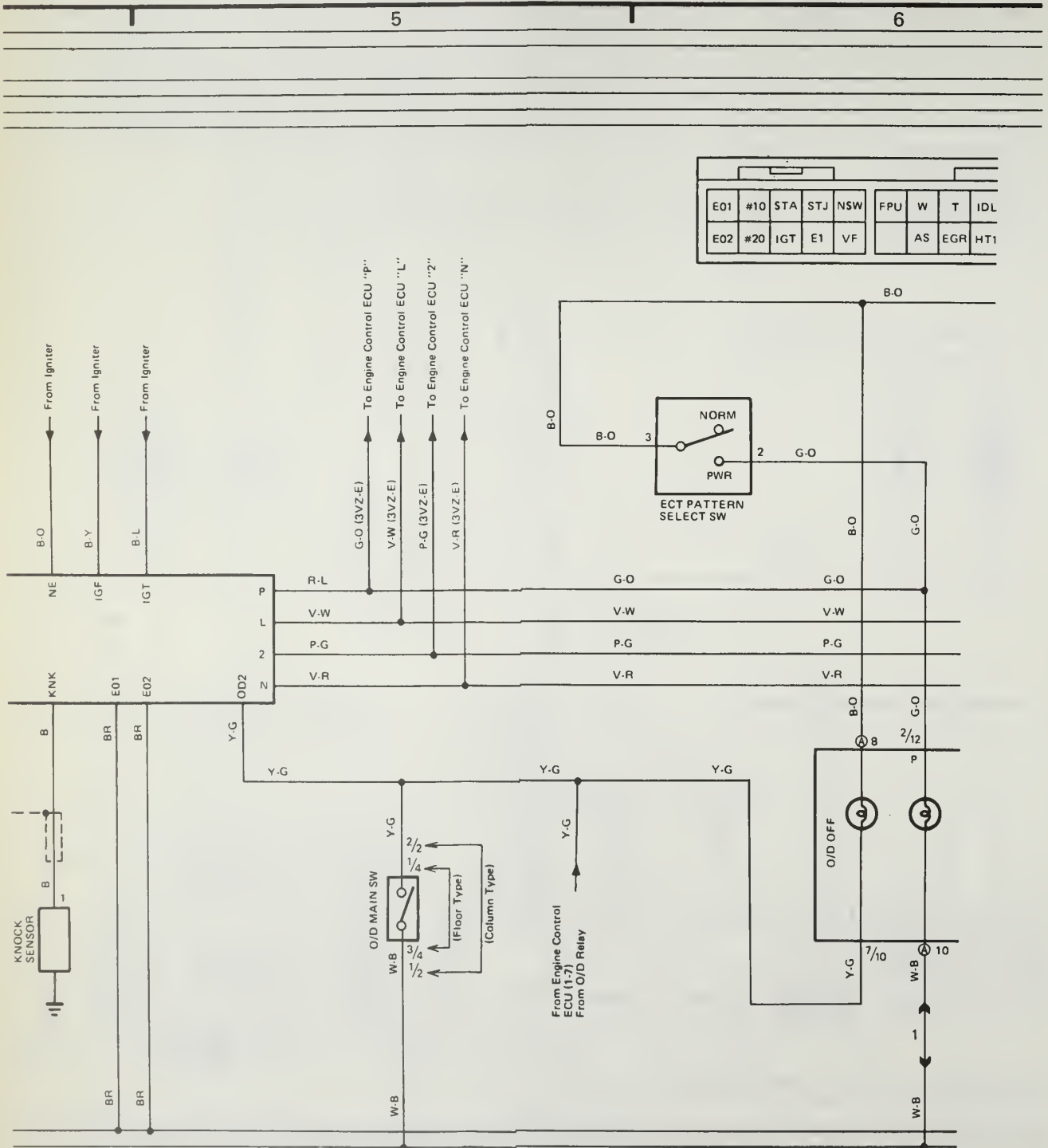


Wiring diagram — 1990 truck

6 CHASSIS ELECTRICAL



Automatic Transmission Indicator

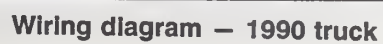


Wiring diagram — 1990 truck

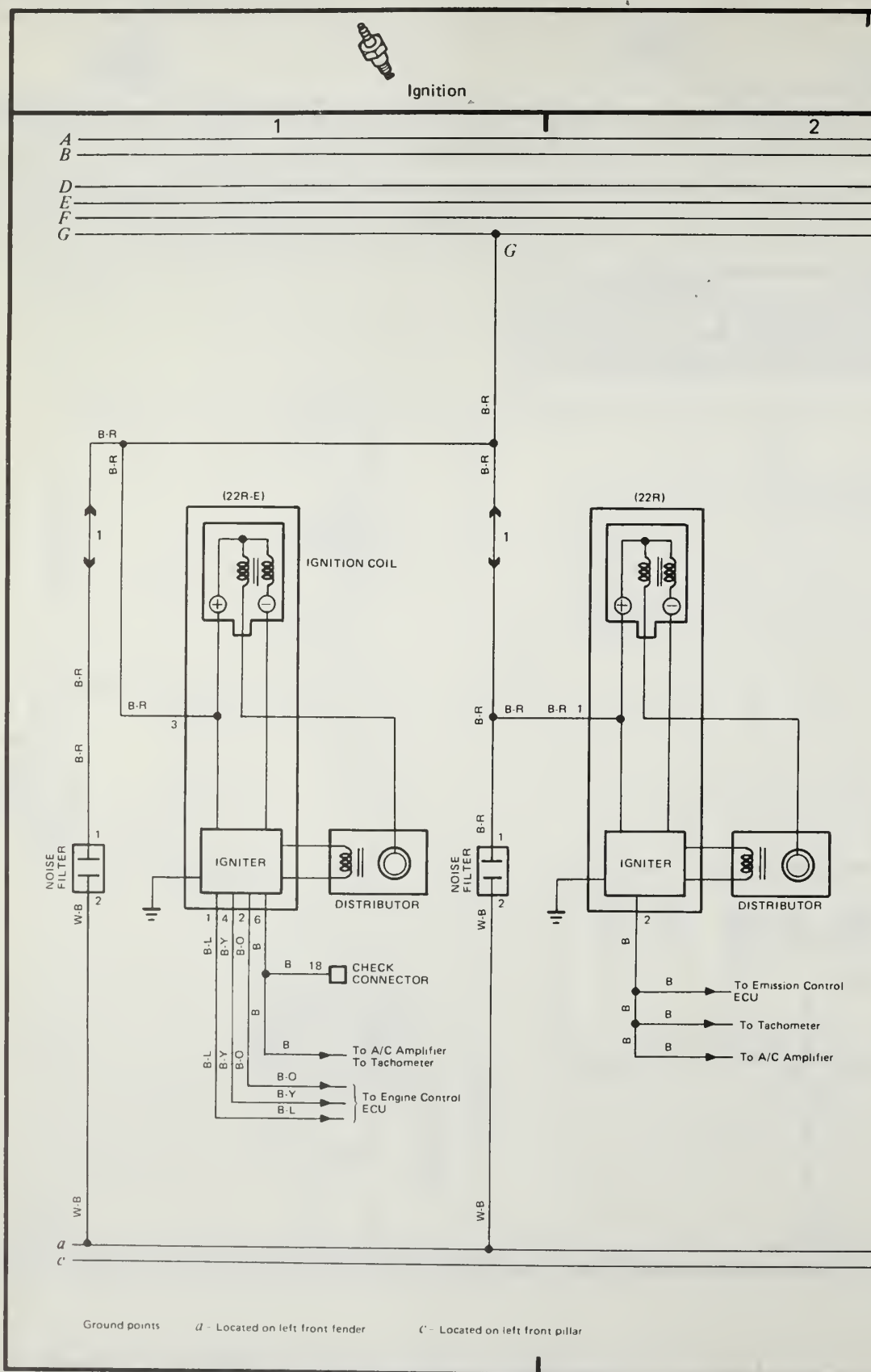


7

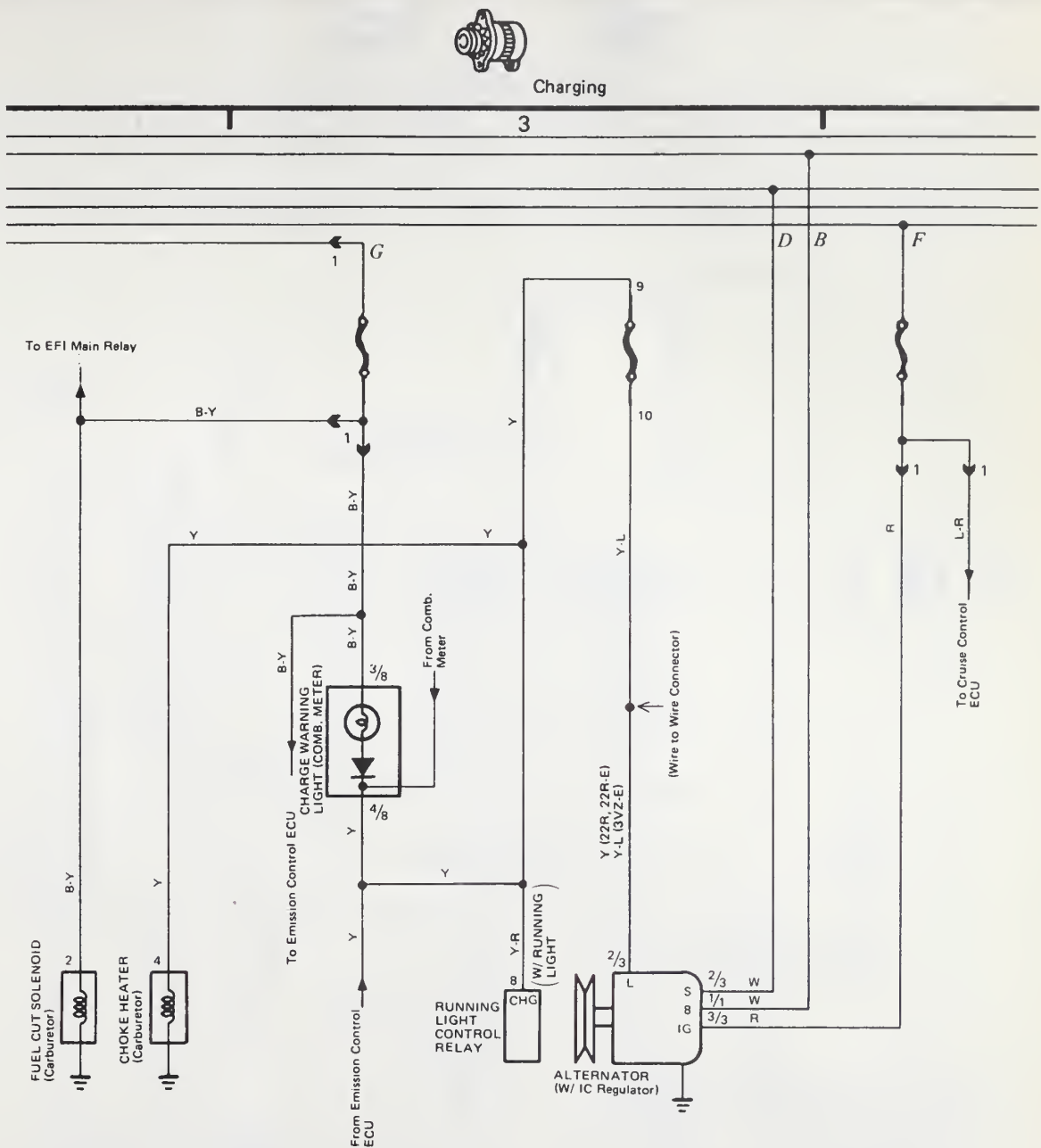
8



6 CHASSIS ELECTRICAL



Wiring diagram — 1990 truck



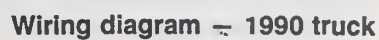
Wiring diagram – 1990 truck

The diagram illustrates the following components and their interconnections:

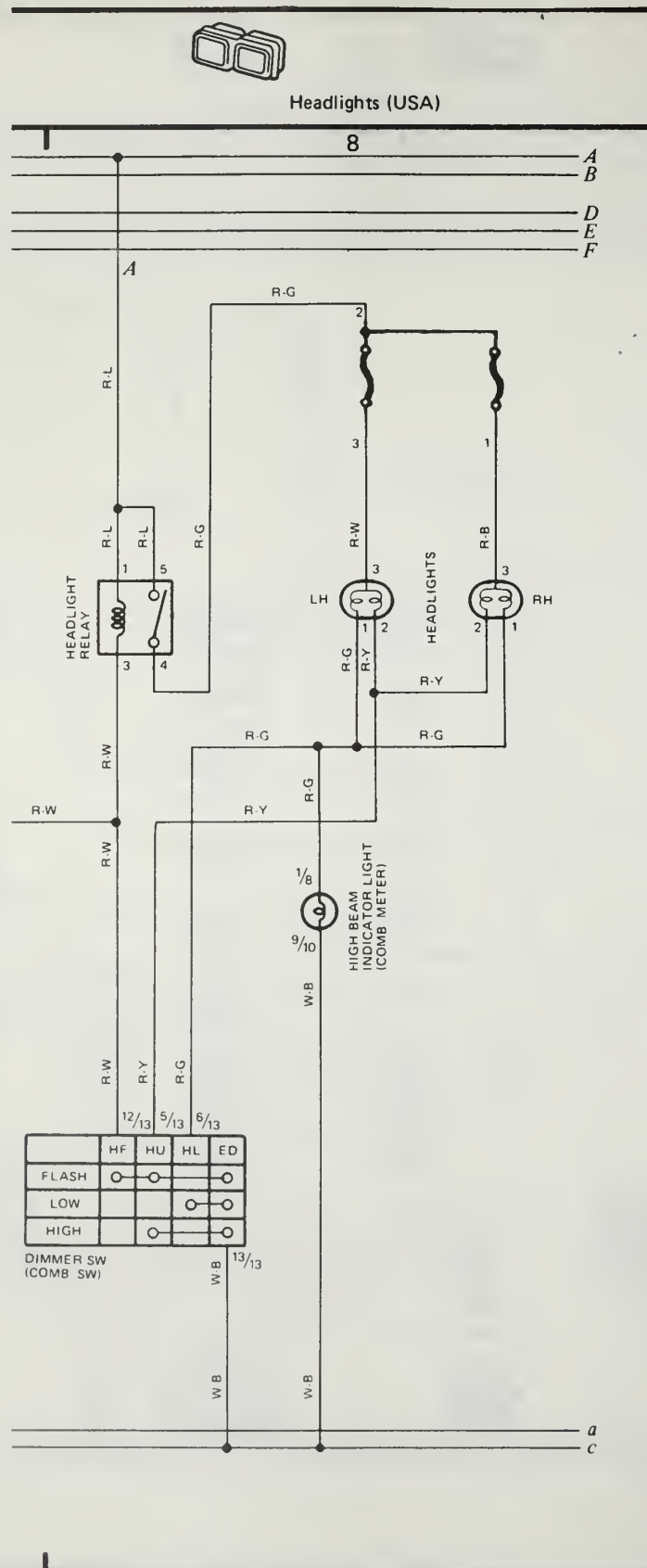
- Heater Relay:** Controls the heater circuit, connected to a fuse and the heater blower switch.
- Blower Motor:** Drives the air flow through the HVAC system, controlled by the blower resistor and blower switch.
- Blower Resistor:** Provides variable resistance to the blower motor for different fan speeds.
- Heater Blower Switch:** Allows manual selection of fan speed and heater function.
- A/C Cut Relay:** Disconnects the compressor clutch when the engine is idling or at low RPM.
- A/C Pressure Switch:** Protects the A/C system from high pressure, which could damage the compressor.
- A/C Amplifier:** Receives signals from the A/C cut relay, pressure switch, water temperature switch, magnet clutch, and thermistor to control the A/C compressor.
- A/C Water Temp Switch:** Prevents the A/C from operating if the engine coolant is too hot.
- A/C Magnet Clutch:** Engages the A/C compressor clutch when commanded by the amplifier.
- Thermistor:** Monitors the evaporator coil temperature to prevent icing.
- EF1 Main Relay:** Controls the main power supply to the A/C system.

The diagram uses standard automotive wiring conventions, with wire colors and labels indicating specific circuits and ground points.

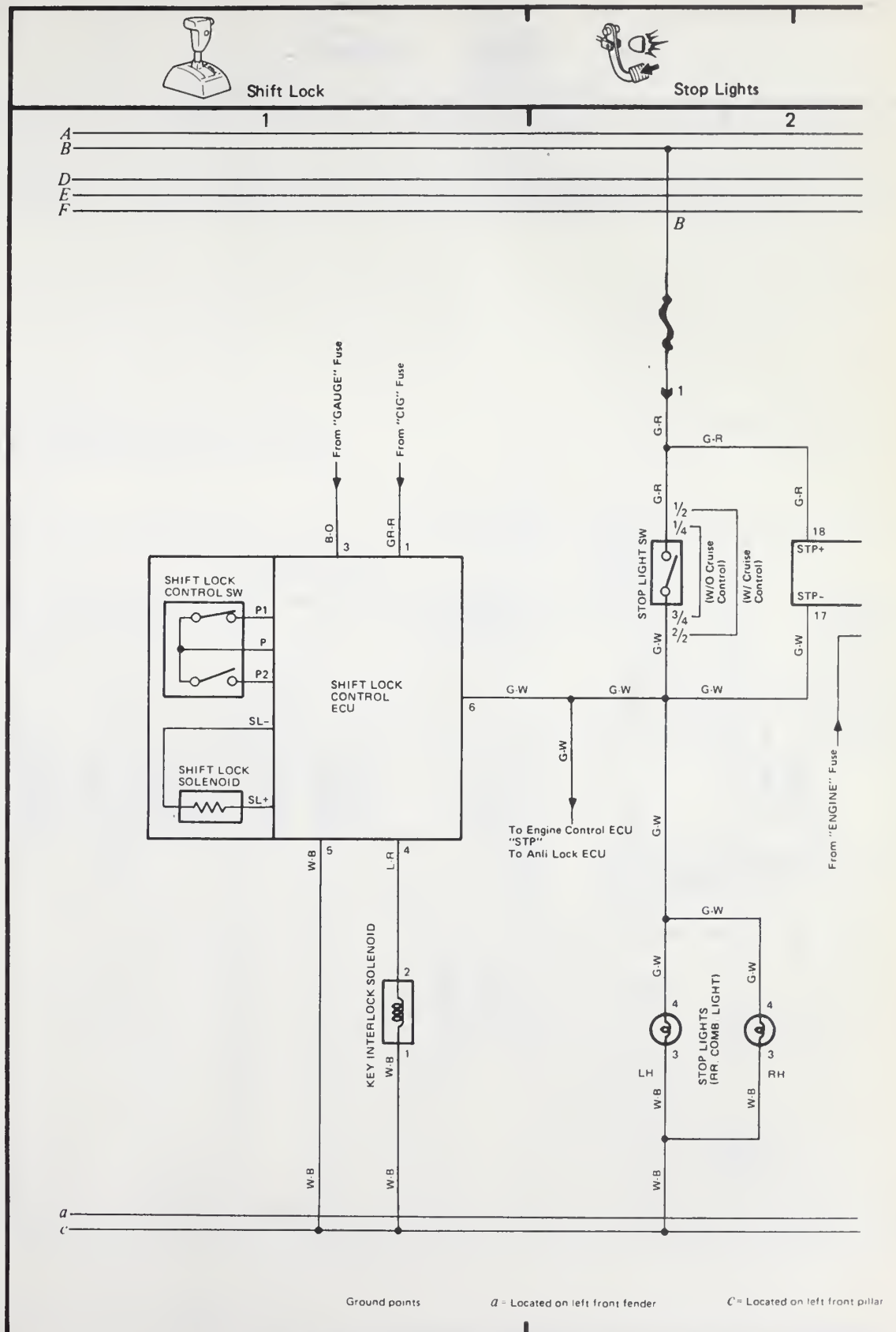
6-86



6 CHASSIS ELECTRICAL

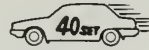


Wiring diagram — 1990 truck

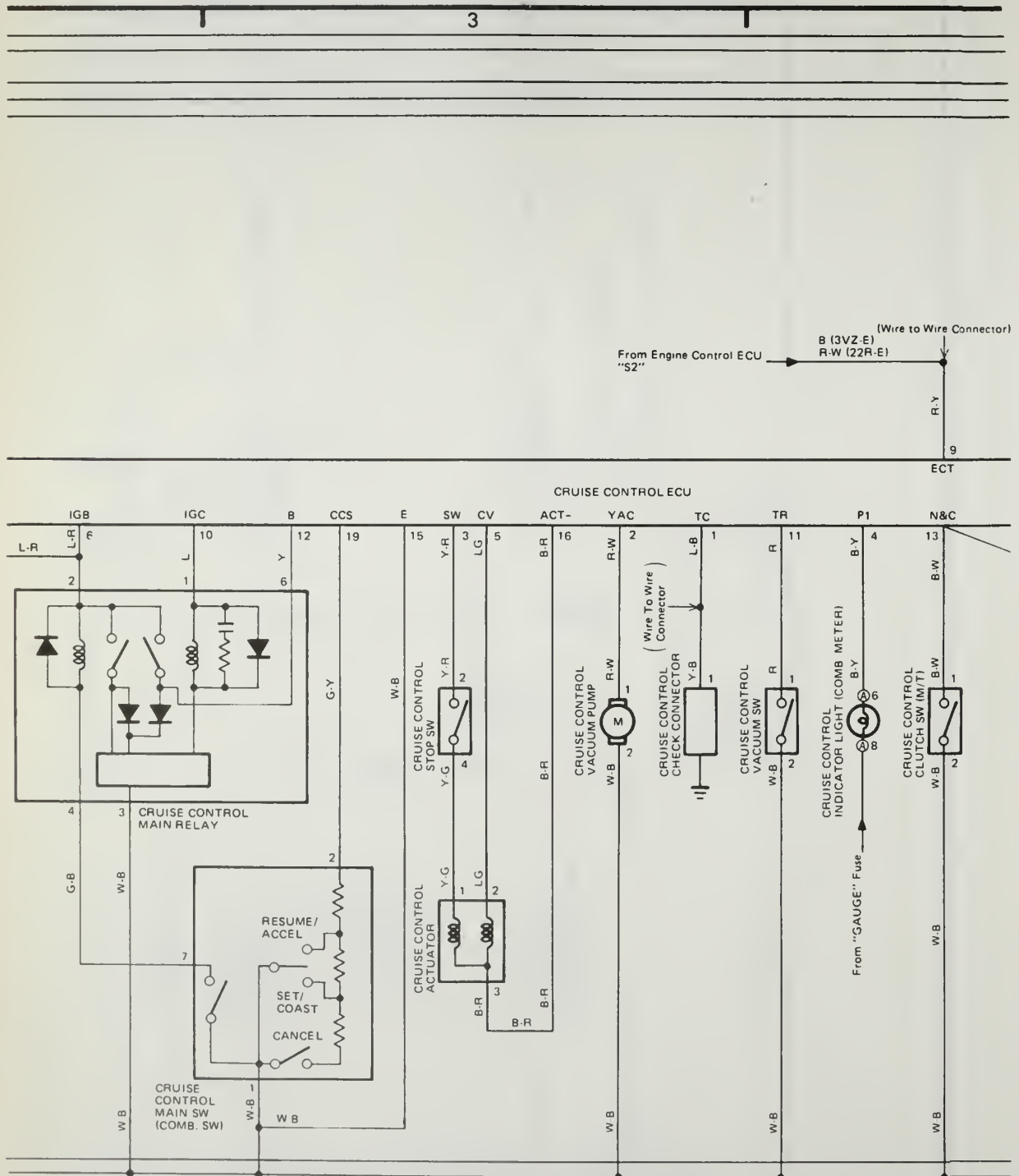


Wiring diagram – 1990 truck

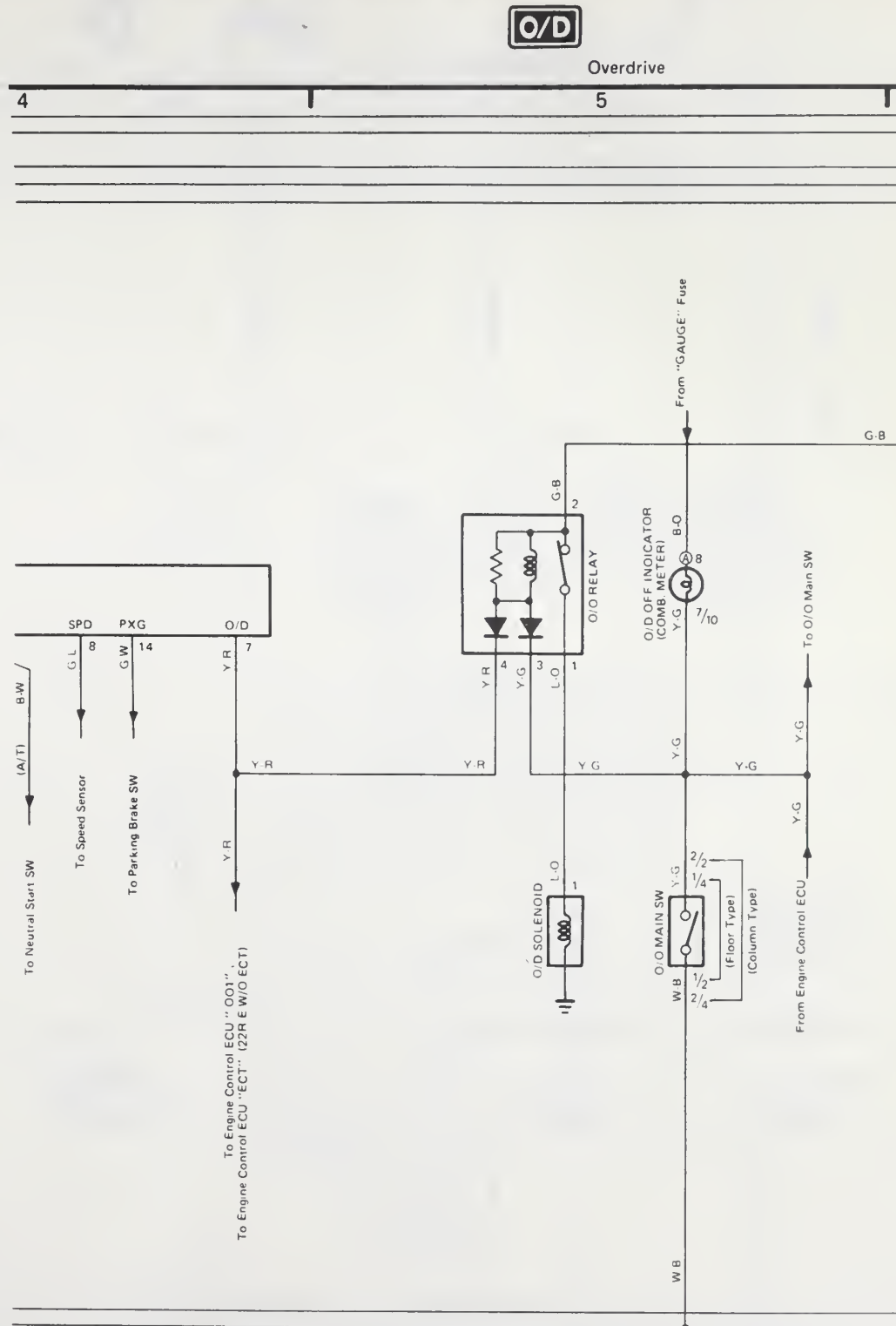
6 CHASSIS ELECTRICAL



Cruise Control

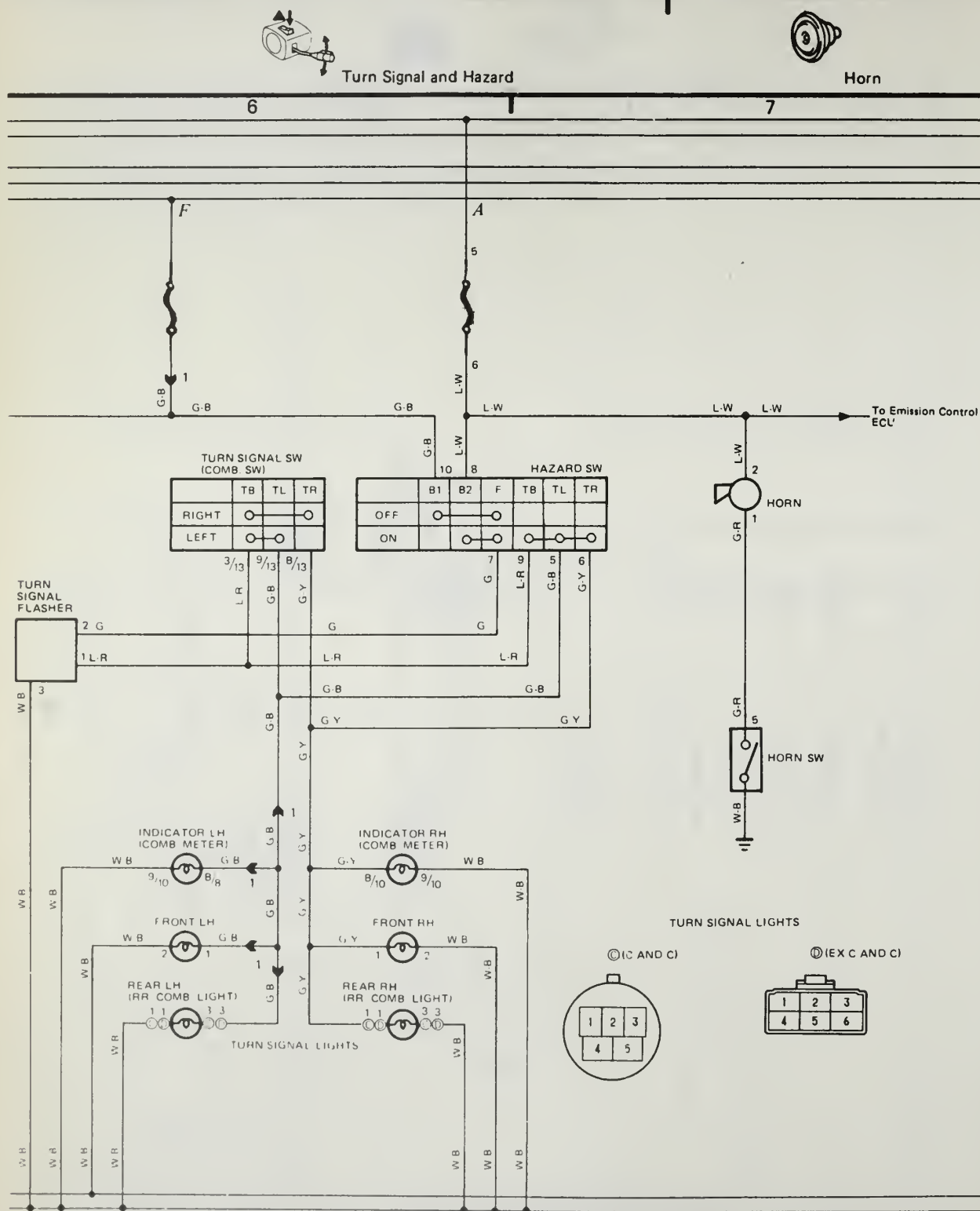


Wiring diagram — 1990 truck

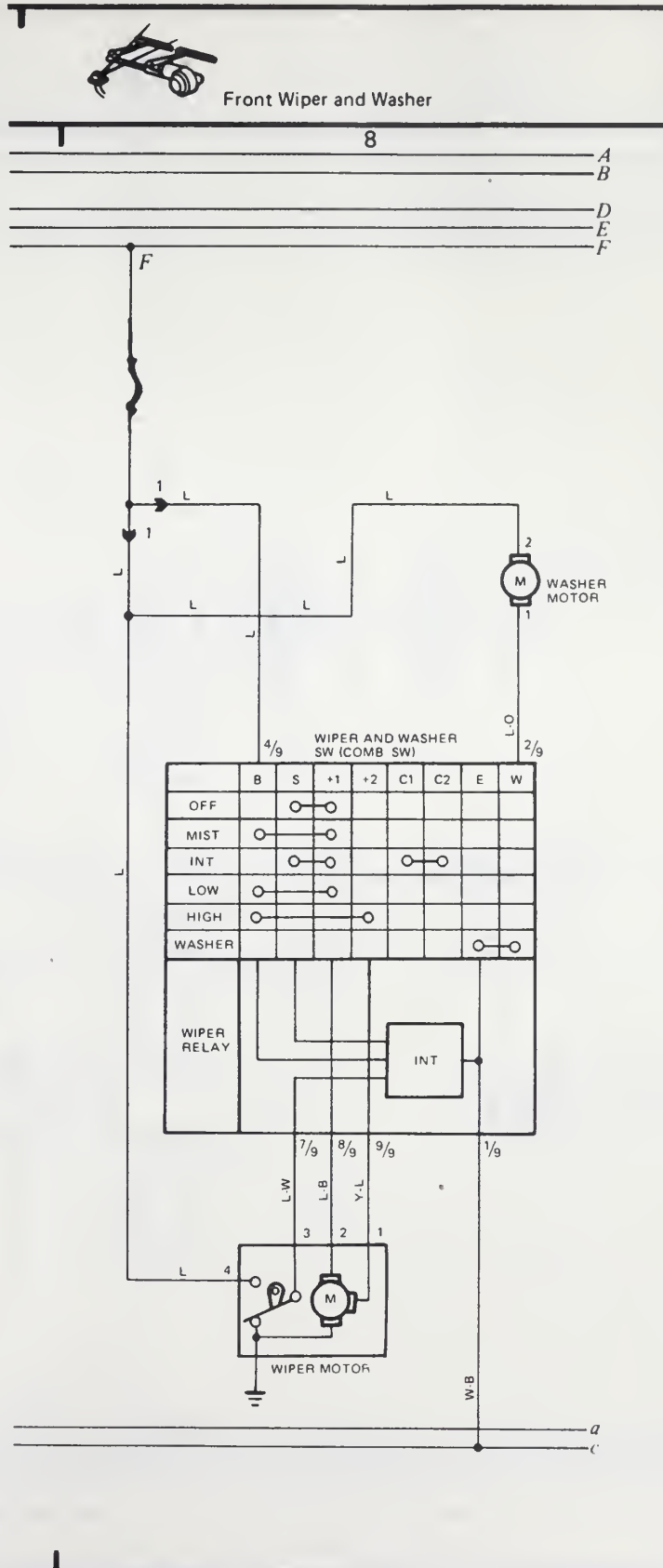


Wiring diagram — 1990 truck

6 CHASSIS ELECTRICAL

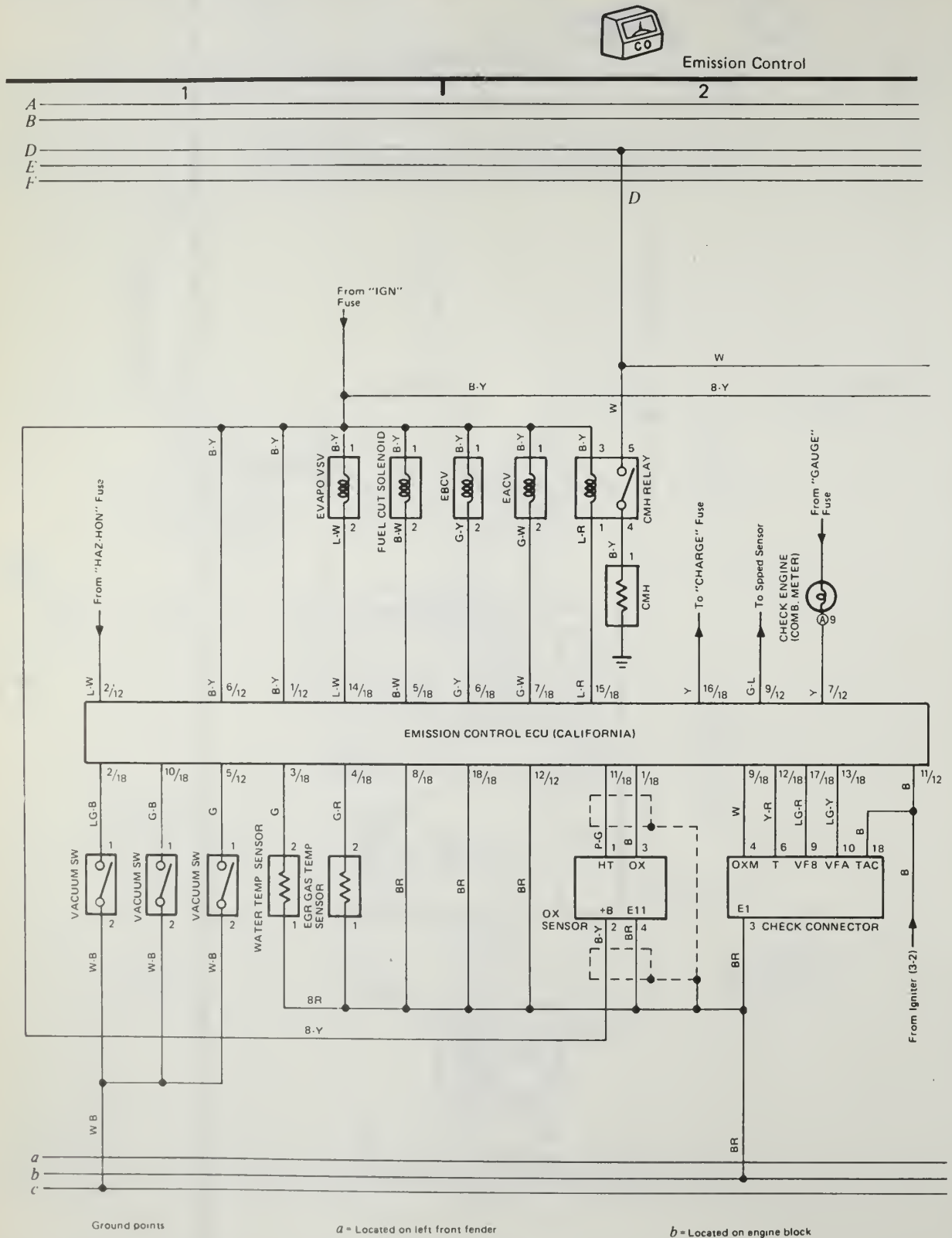


Wiring diagram — 1990 truck



Wiring diagram — 1990 truck

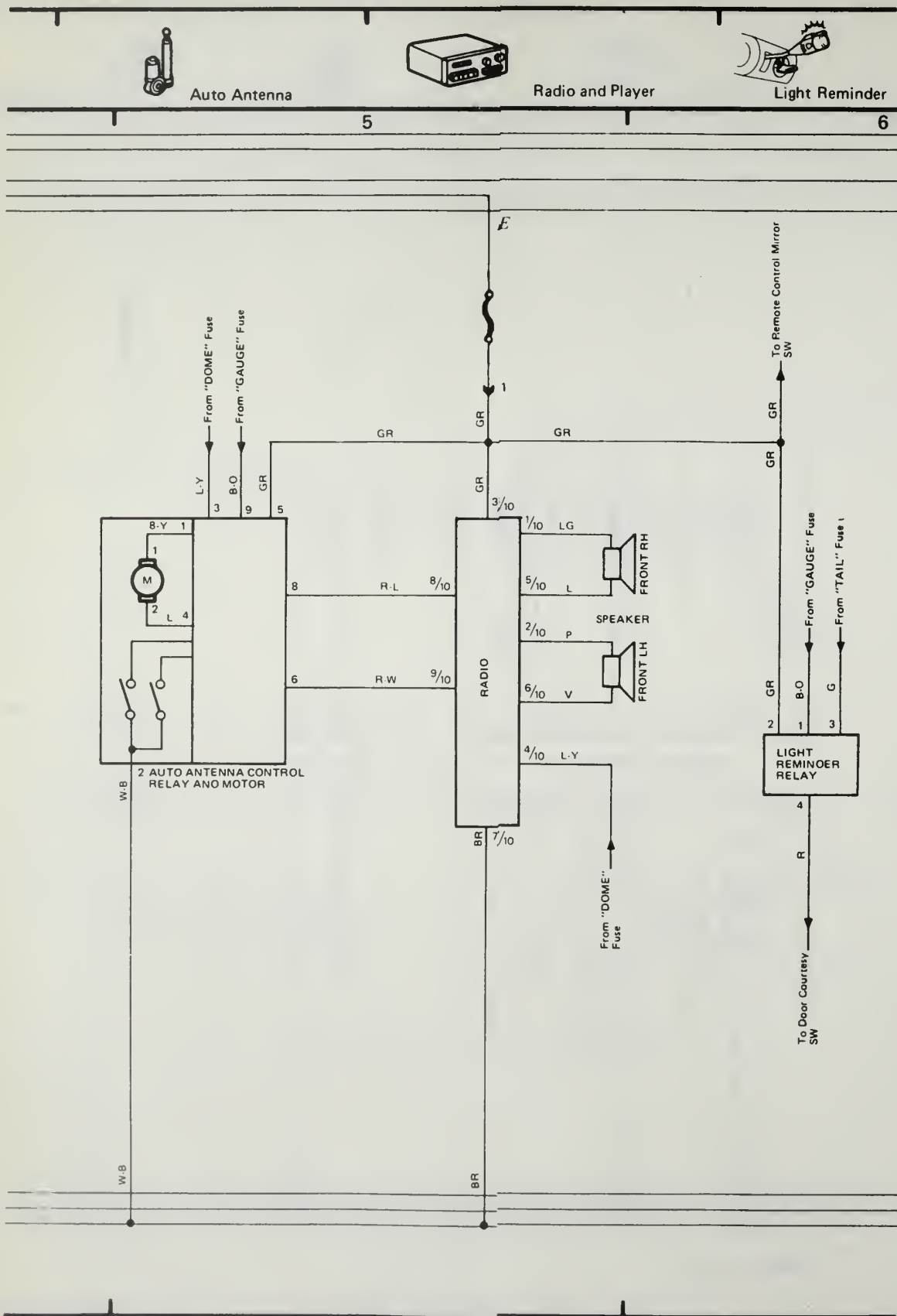
6 CHASSIS ELECTRICAL



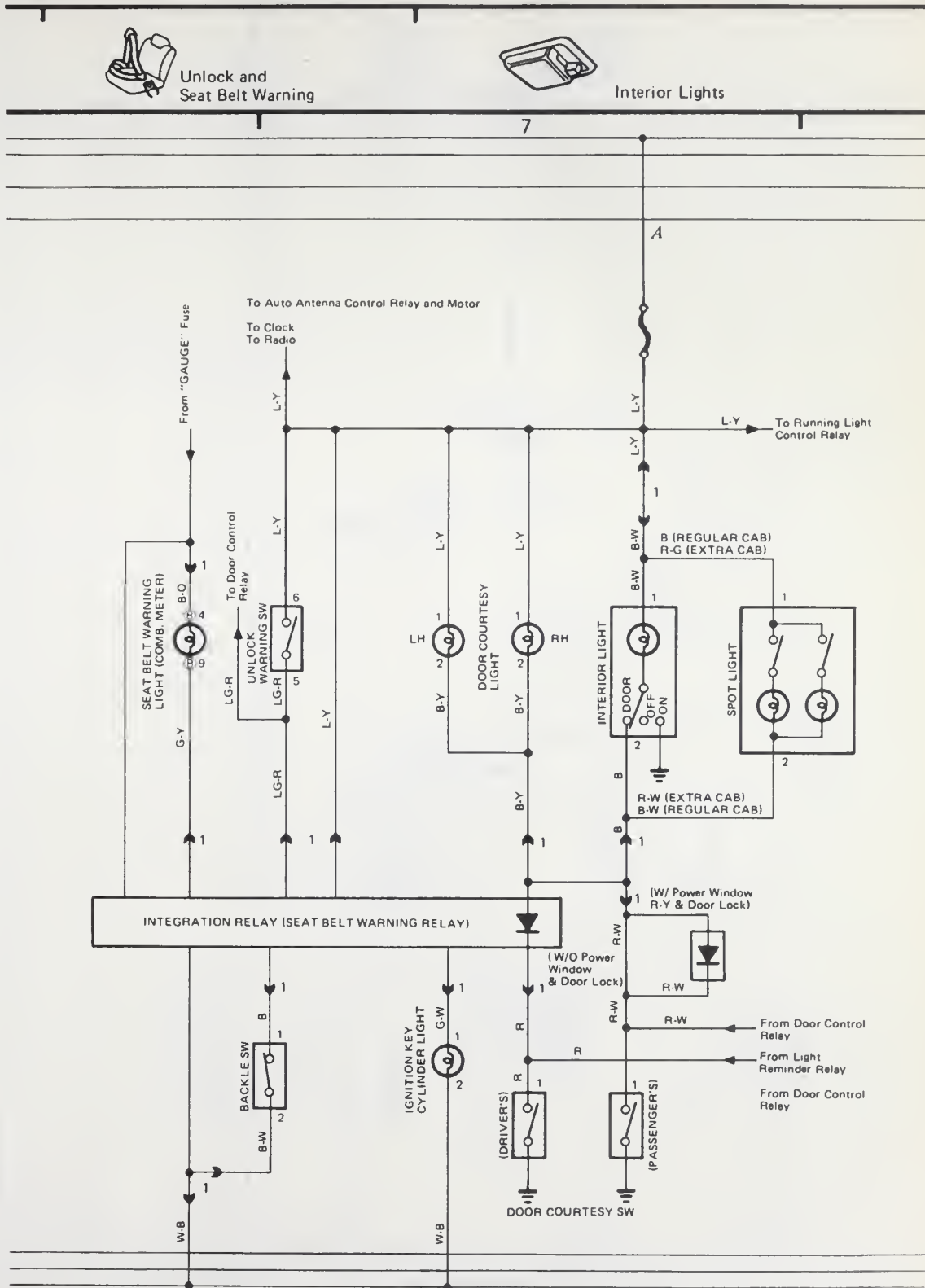


6-95

6 CHASSIS ELECTRICAL

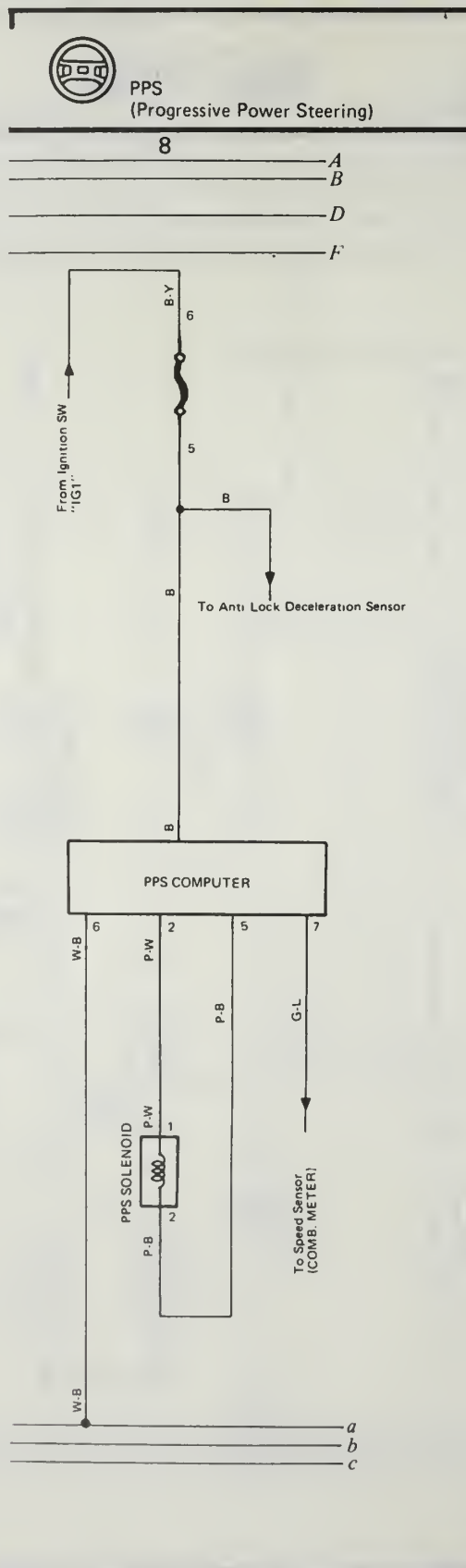


Wiring diagram – 1990 truck



Wiring diagram – 1990 truck

6 CHASSIS ELECTRICAL



Wiring diagram — 1990 truck

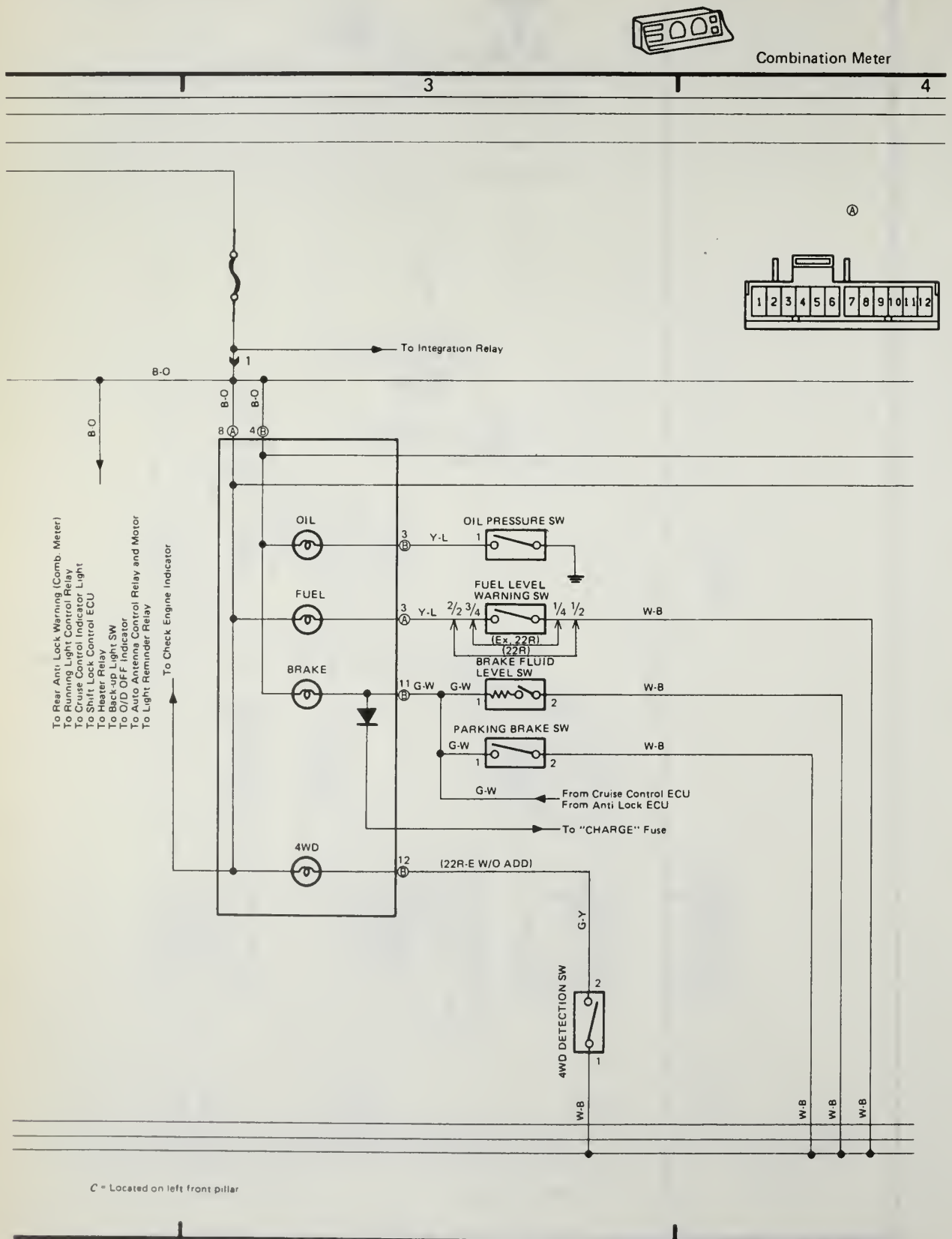


A = Located on left front fender

b = Located on engine block

Wiring diagram – 1990 truck

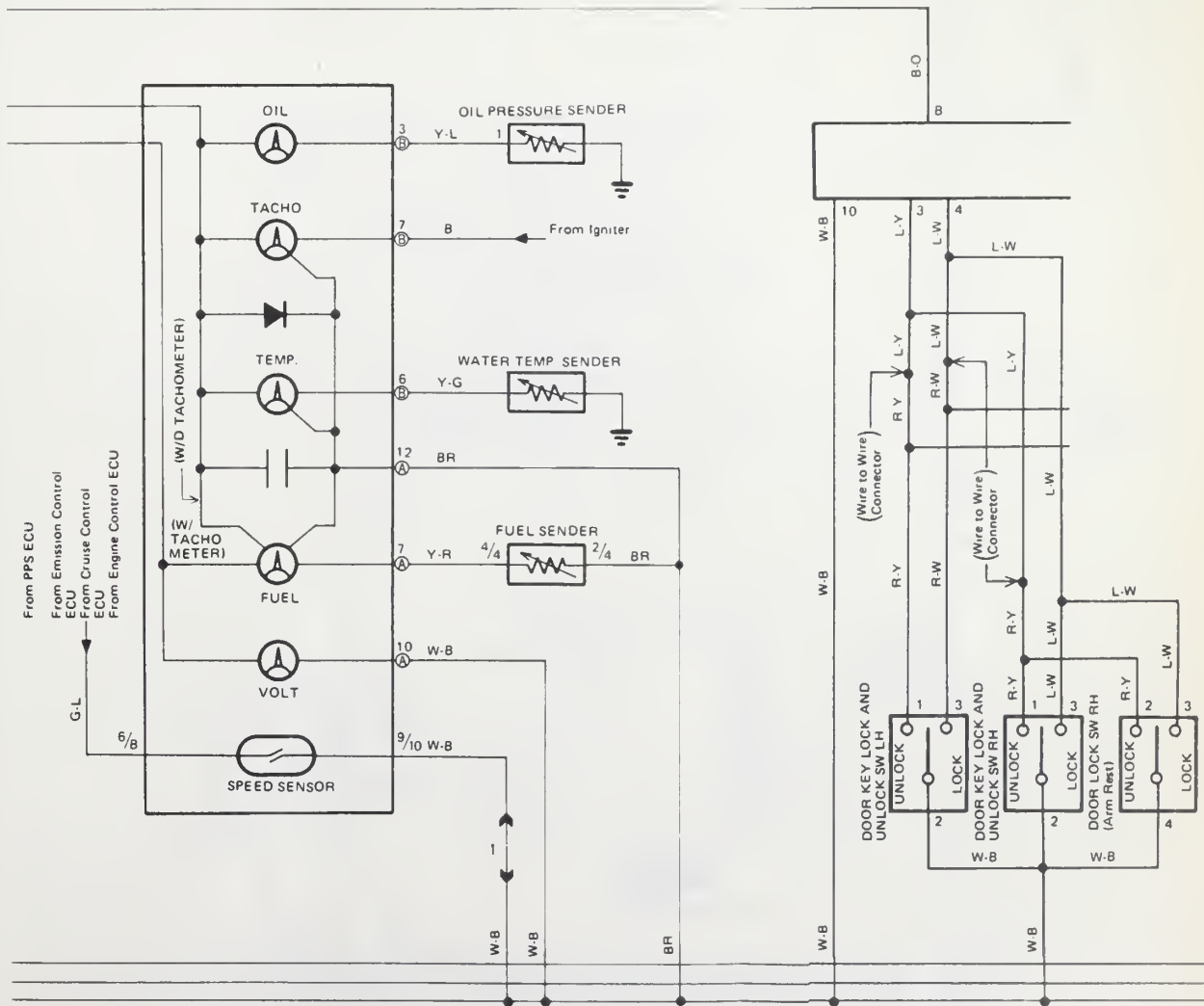
6 CHASSIS ELECTRICAL



Wiring diagram — 1990 truck

5

Ⓟ BLUE

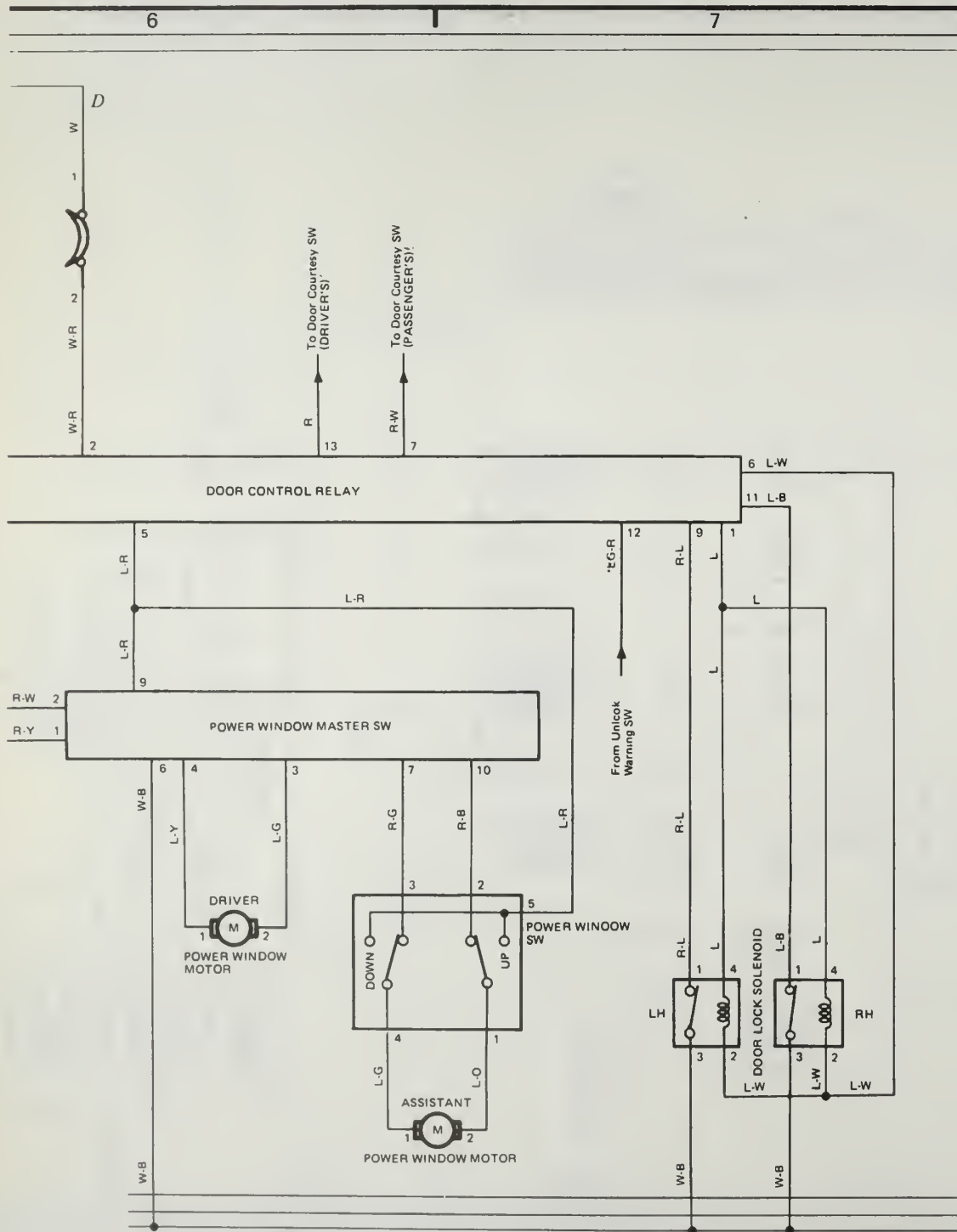


Wiring diagram — 1990 truck

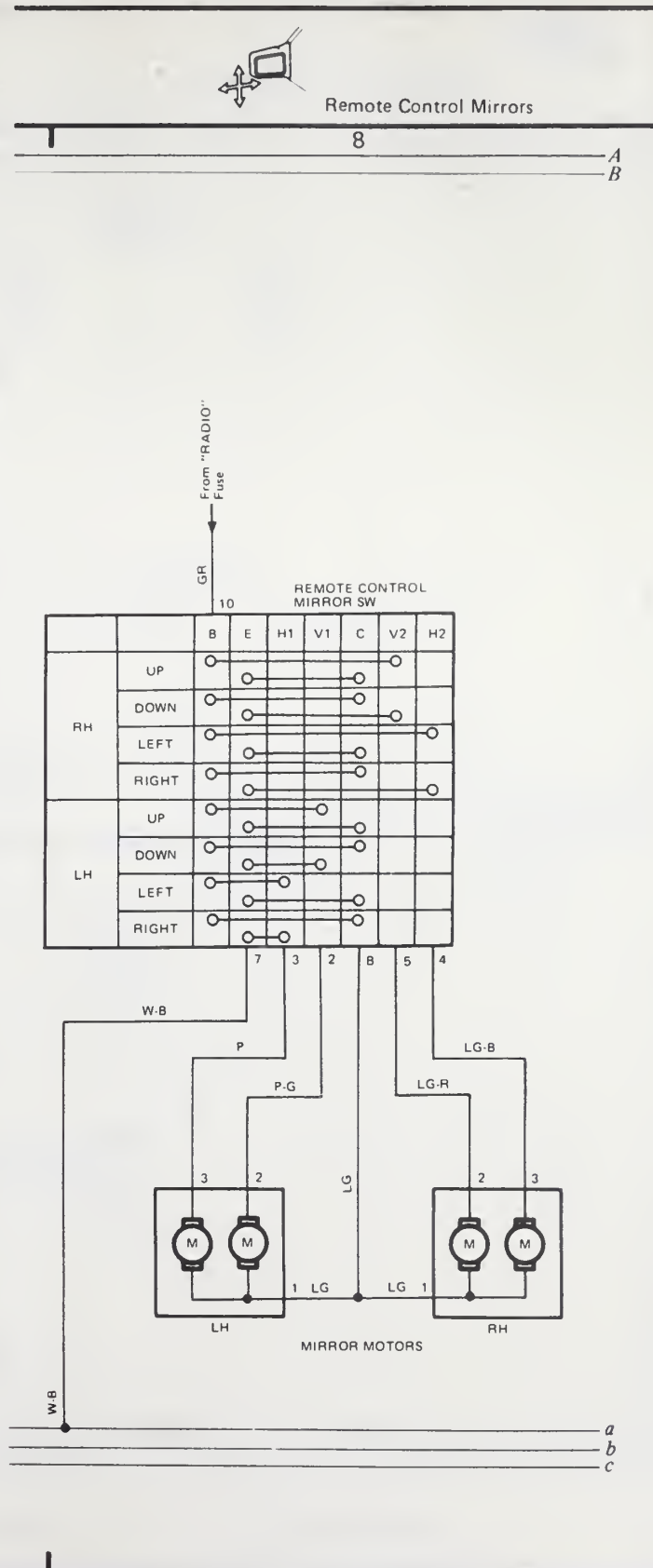
6 CHASSIS ELECTRICAL



Power Windows and Door Locks

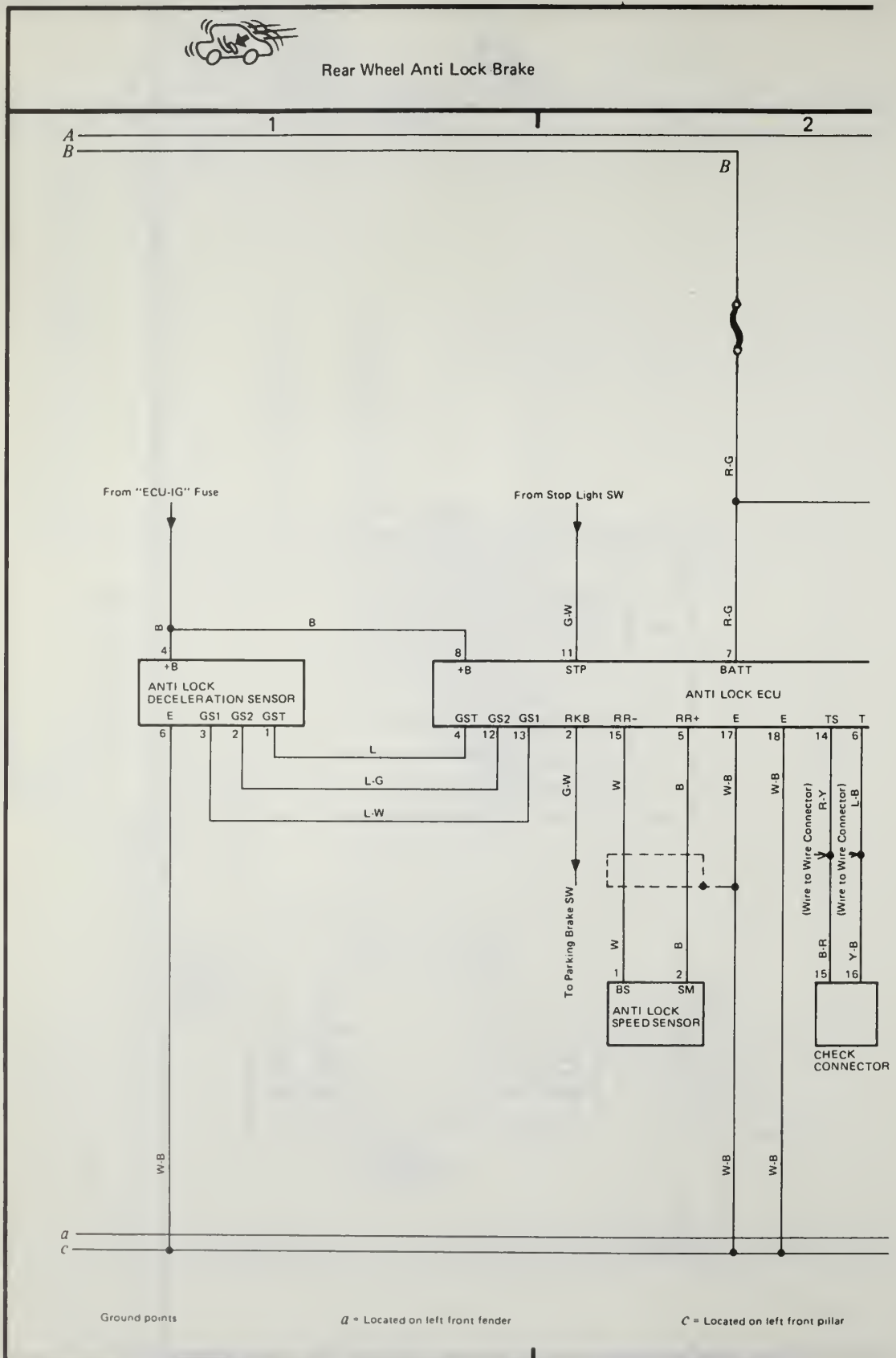


Wiring diagram — 1990 truck

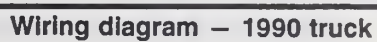


Wiring diagram — 1990 truck

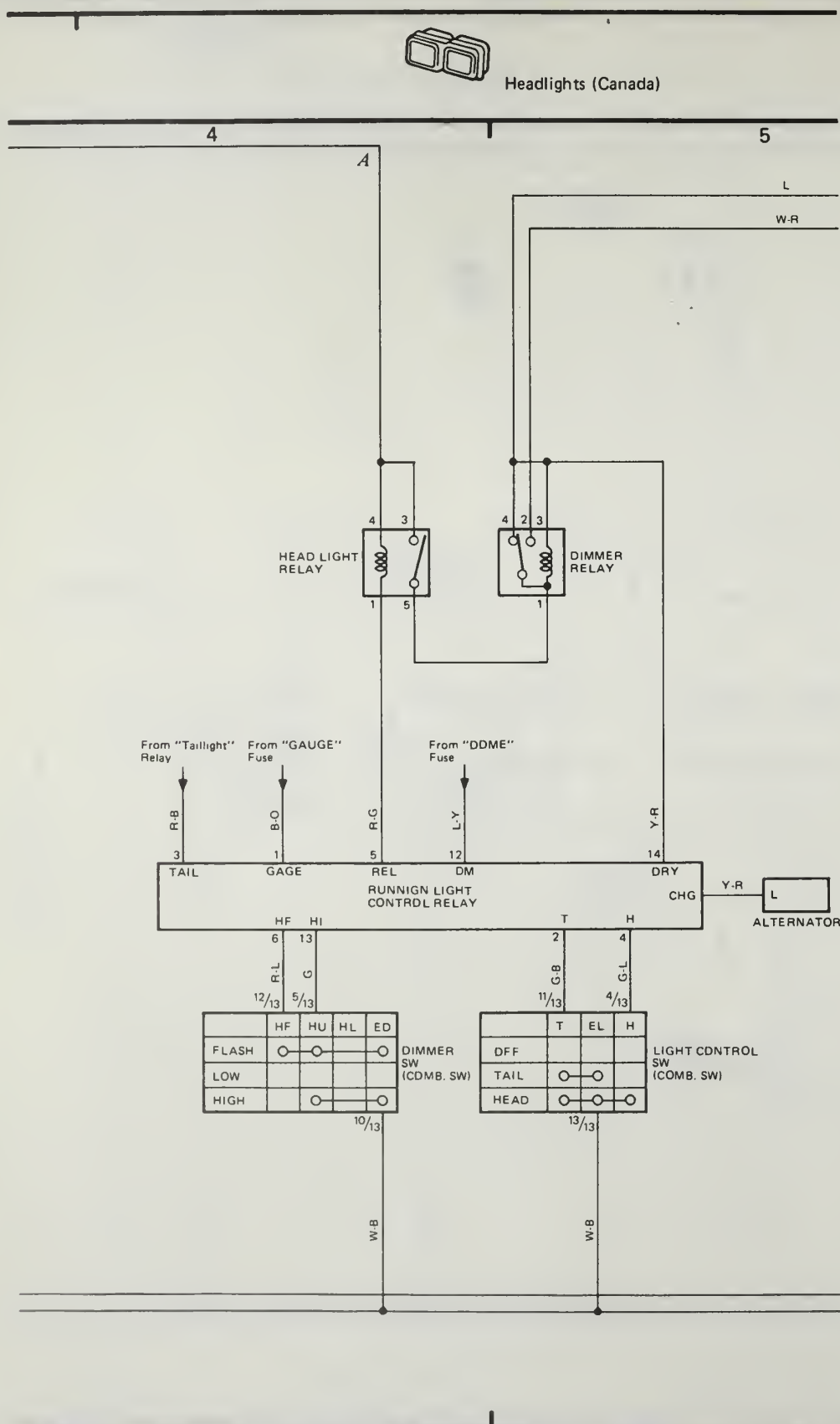
6 CHASSIS ELECTRICAL



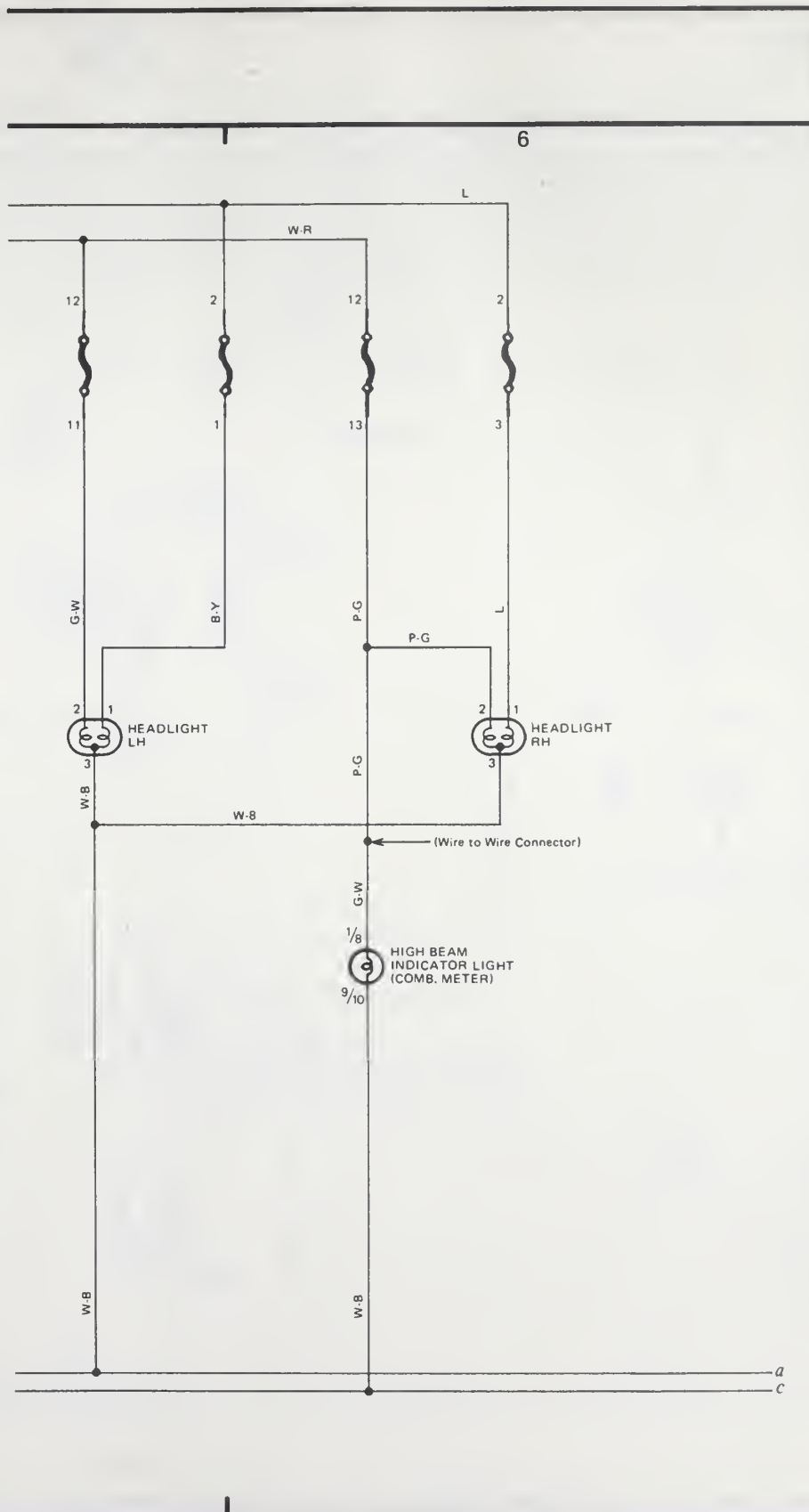
Wiring diagram — 1990 truck



6 CHASSIS ELECTRICAL

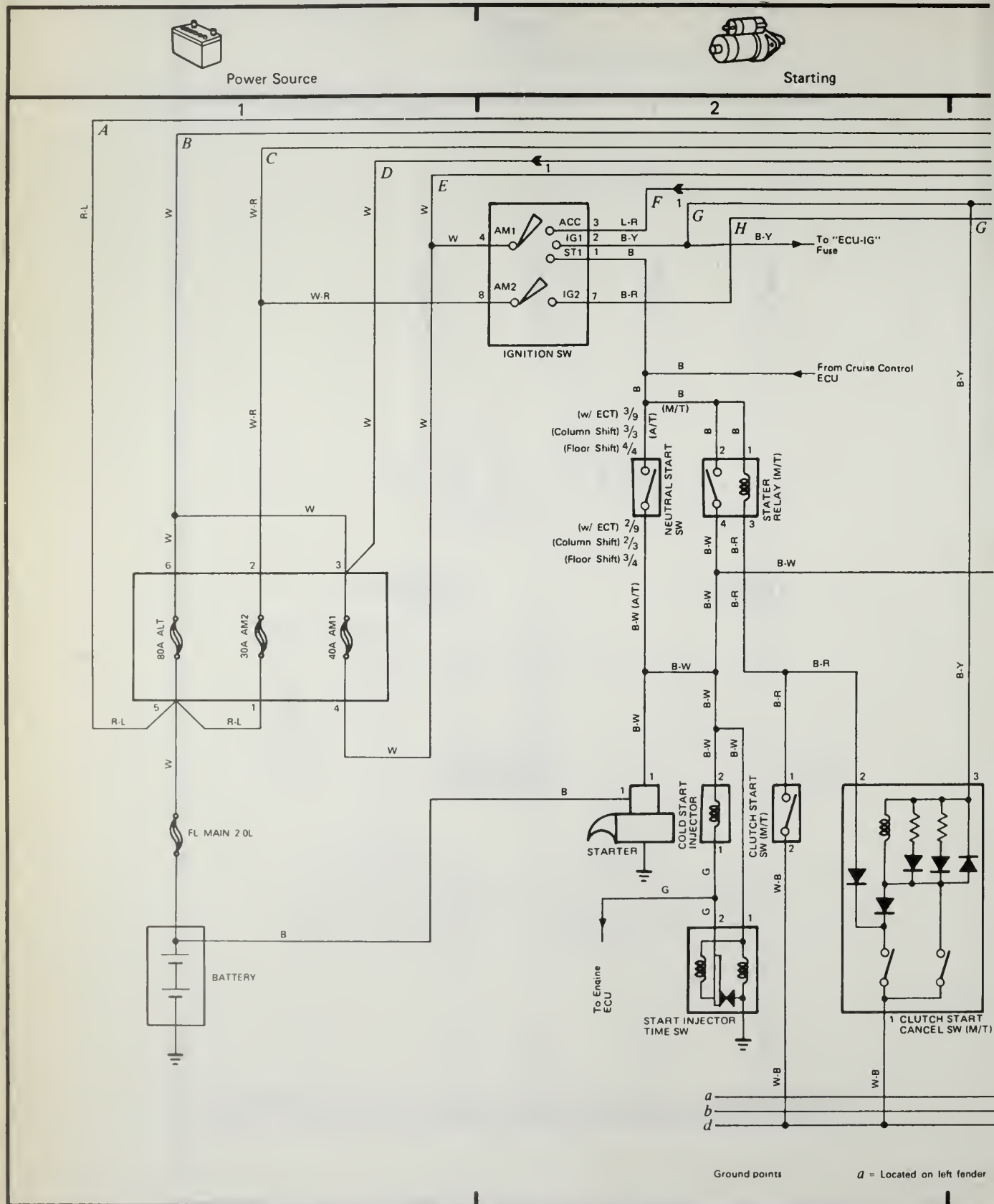


Wiring diagram — 1990 truck

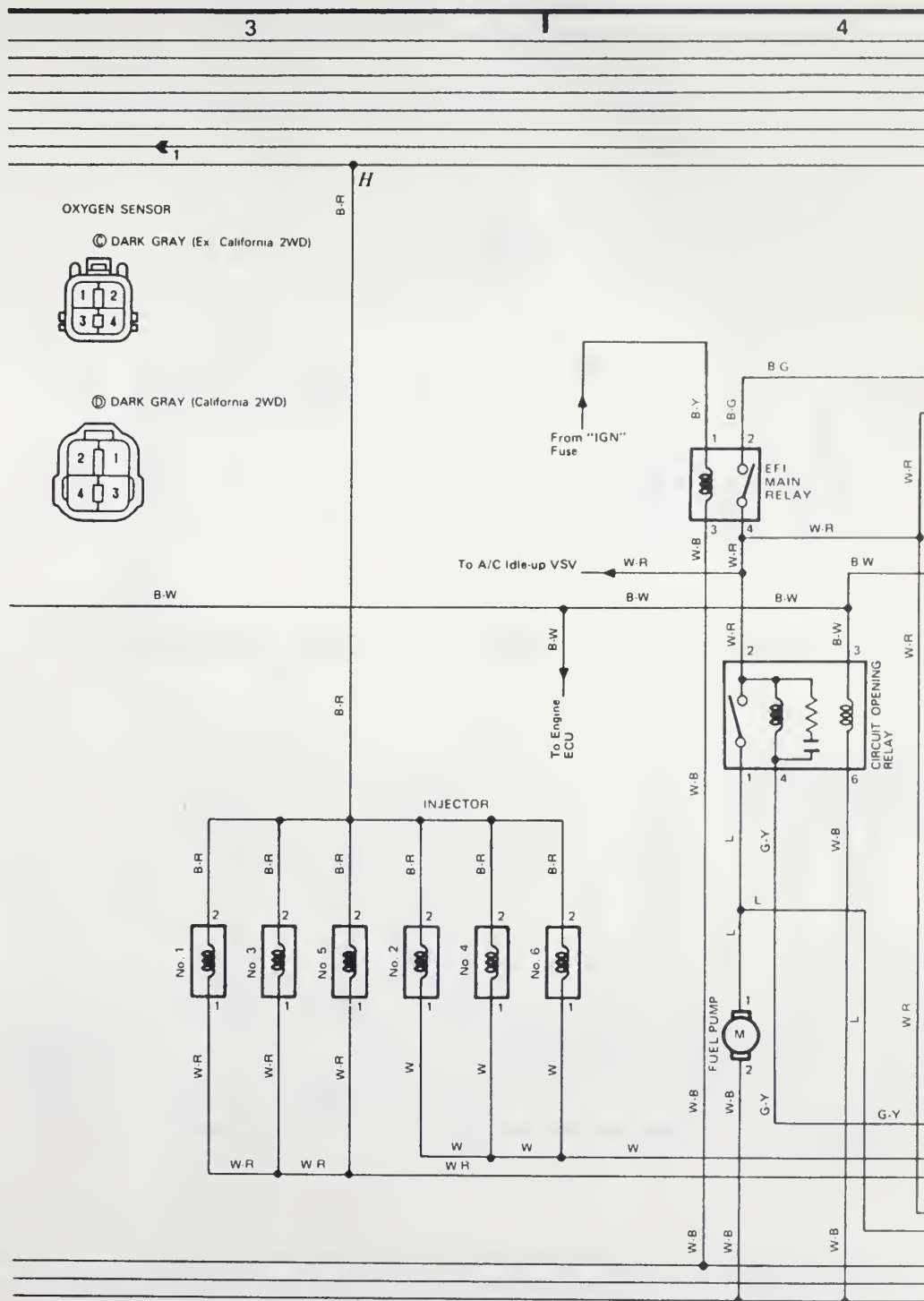


Wiring diagram — 1990 truck

6 CHASSIS ELECTRICAL



Wiring diagram – 1991 truck



b = Located on camshaft bearing cap

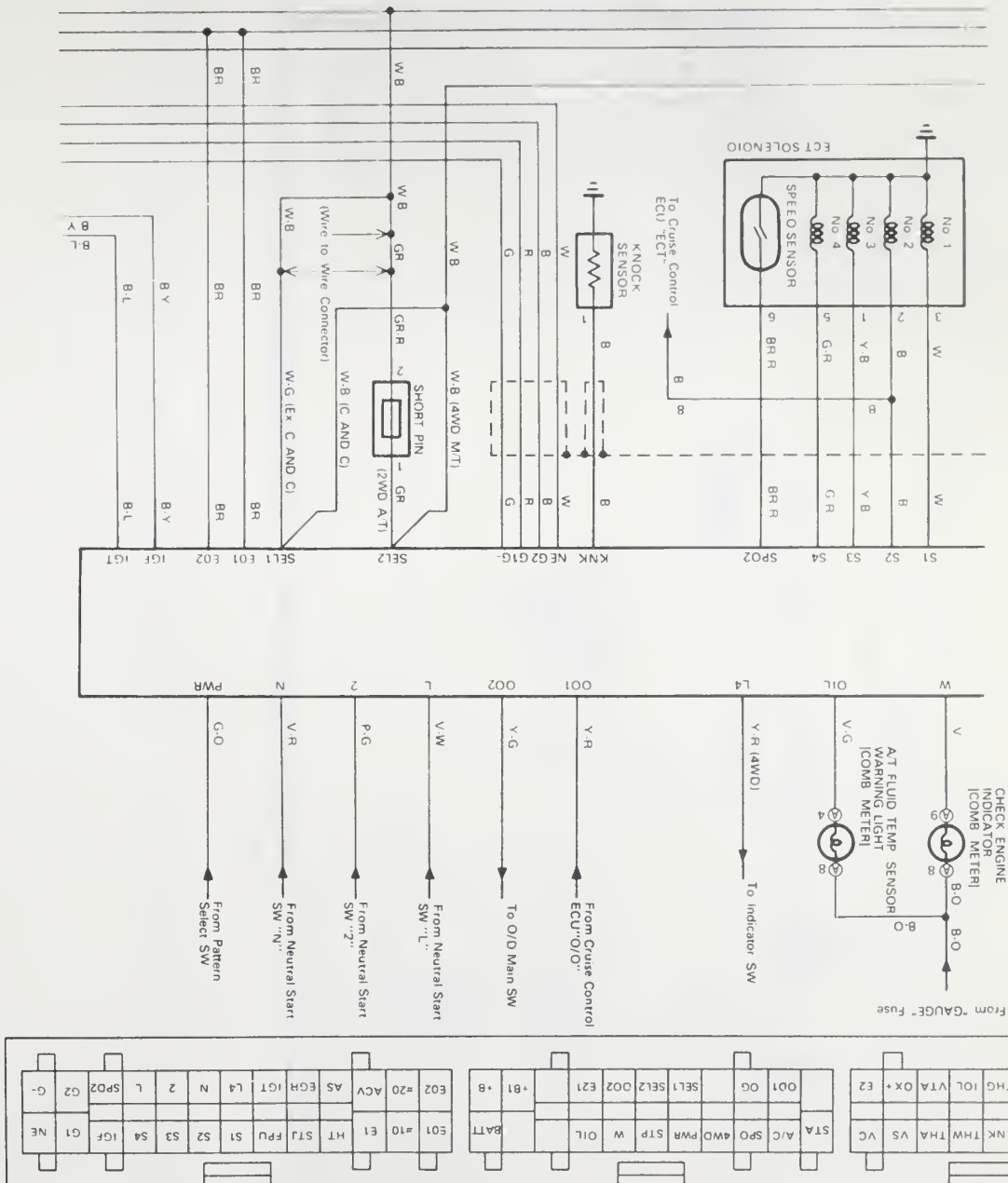
d = Located on left kick panel

Wiring diagram — 1991 truck

[illegible]

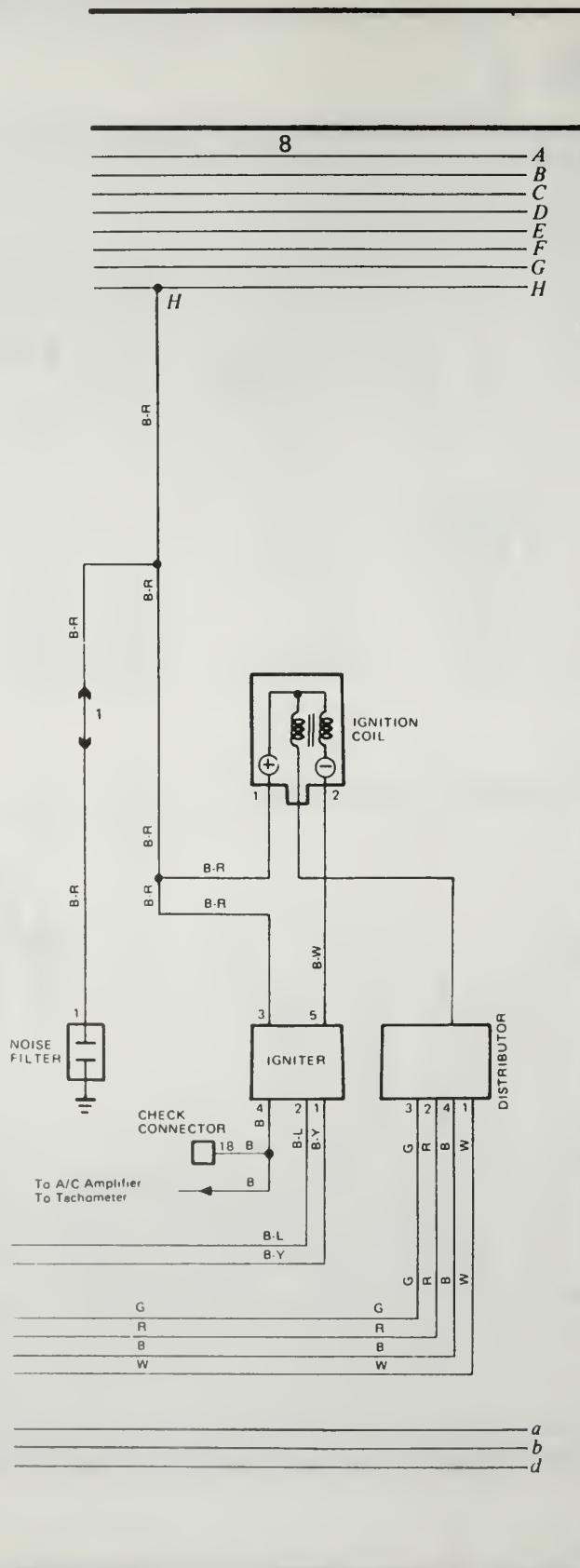
6-110

CHASSIS ELECTRICAL 6

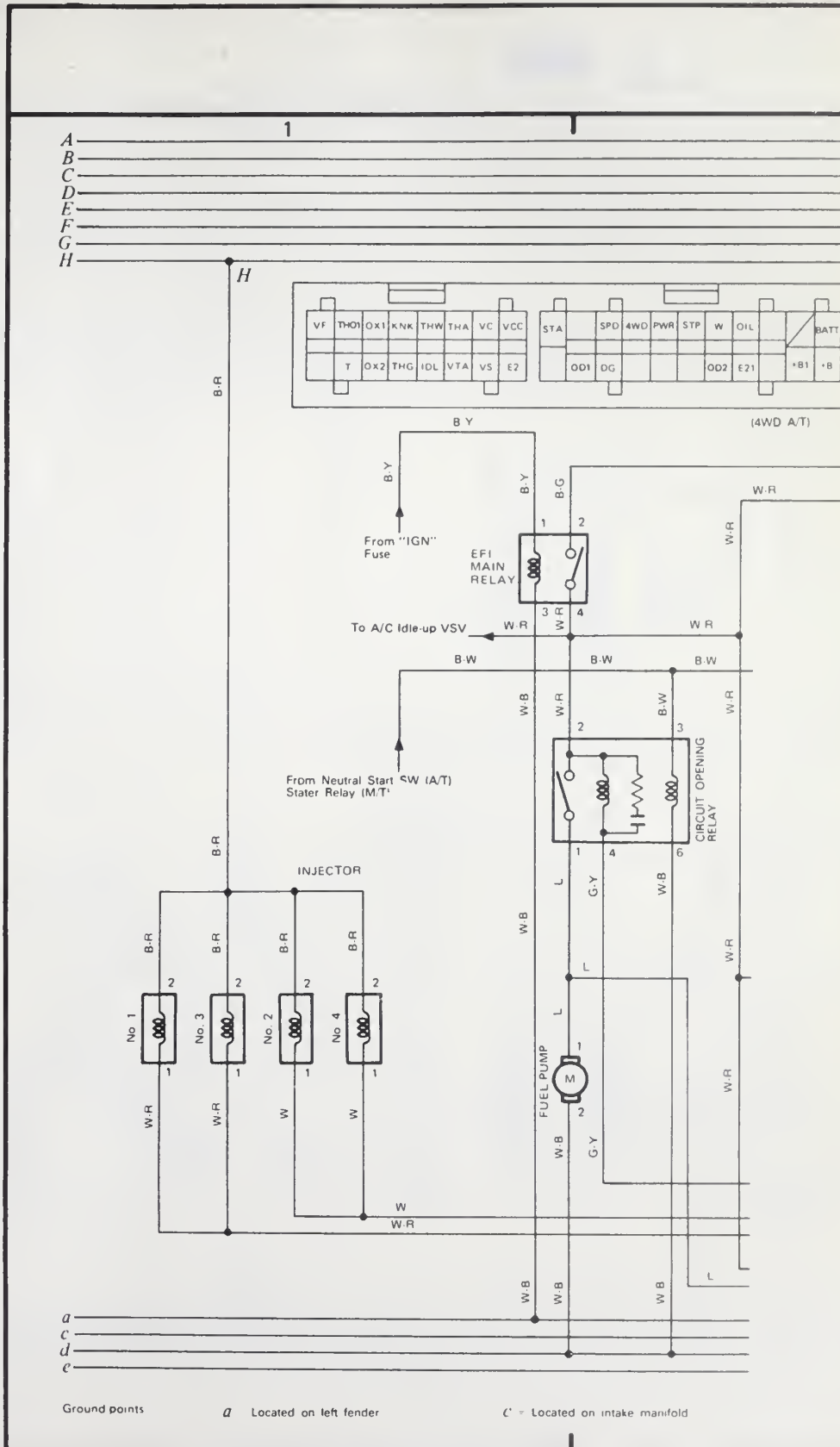


Wiring diagram – 1991 truck

6 CHASSIS ELECTRICAL



Wiring diagram — 1991 truck



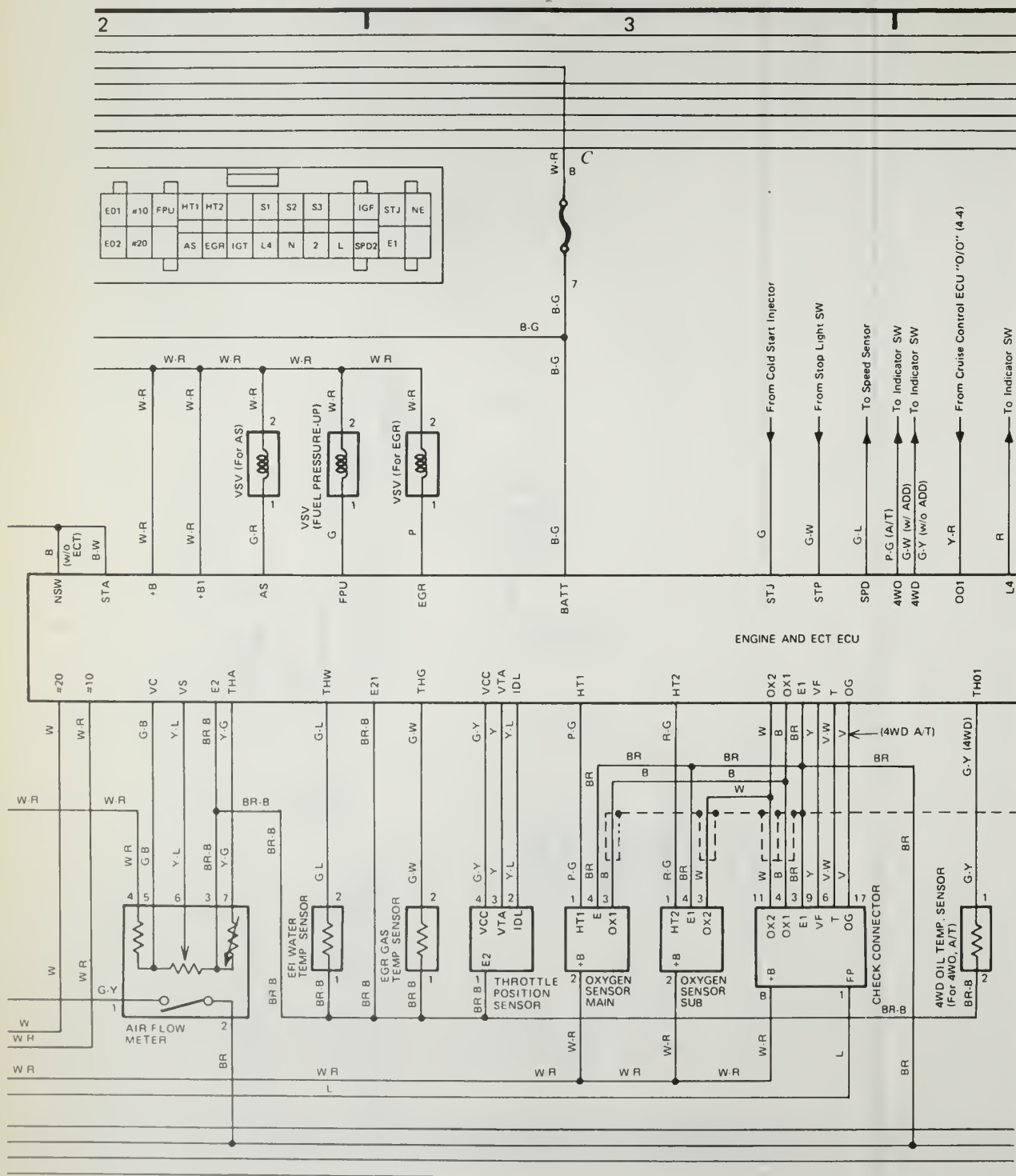
Wiring diagram — 1991 truck

6 CHASSIS ELECTRICAL



ECT

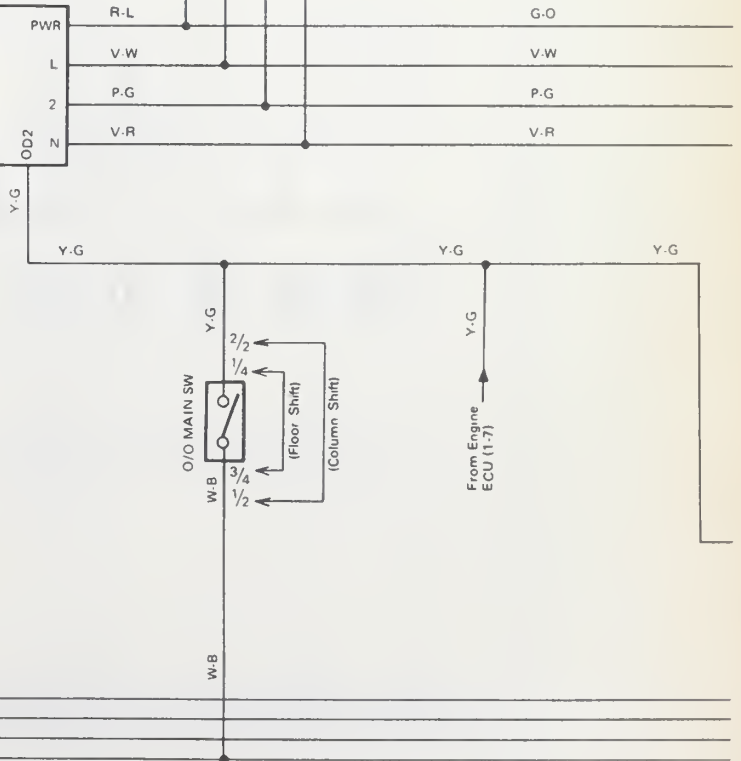
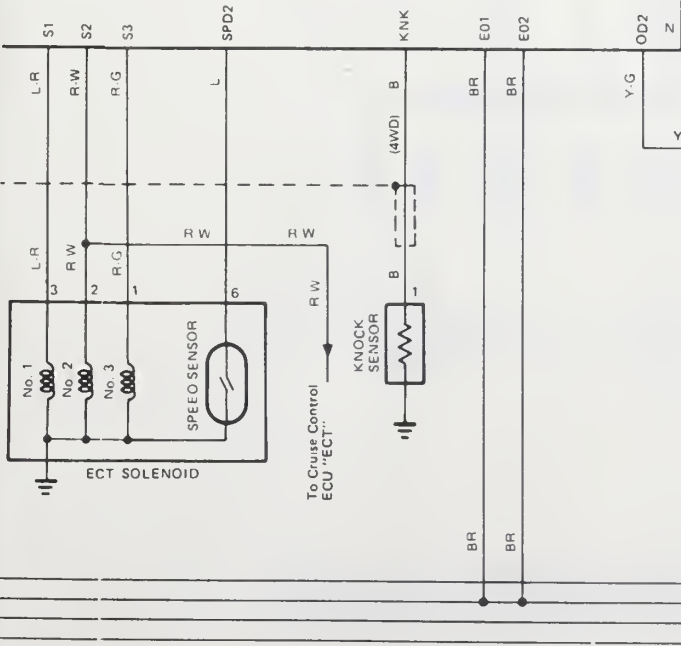
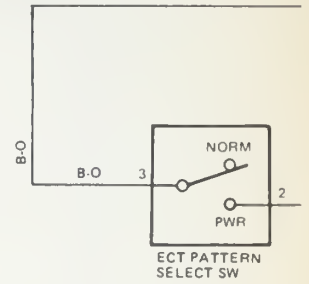
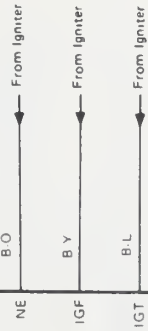
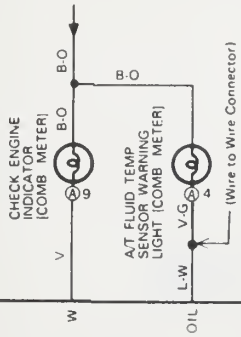
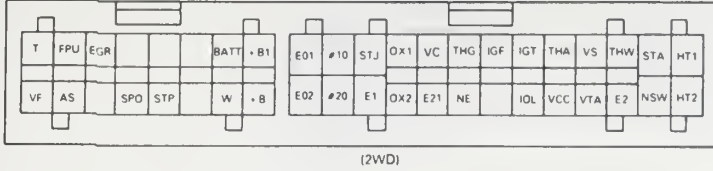
Engine Control and ECT (22R-E)



d Located on left kick panel

e Located on right kick panel

Wiring diagram — 1991 truck



Wiring diagram – 1991 truck

6 CHASSIS ELECTRICAL



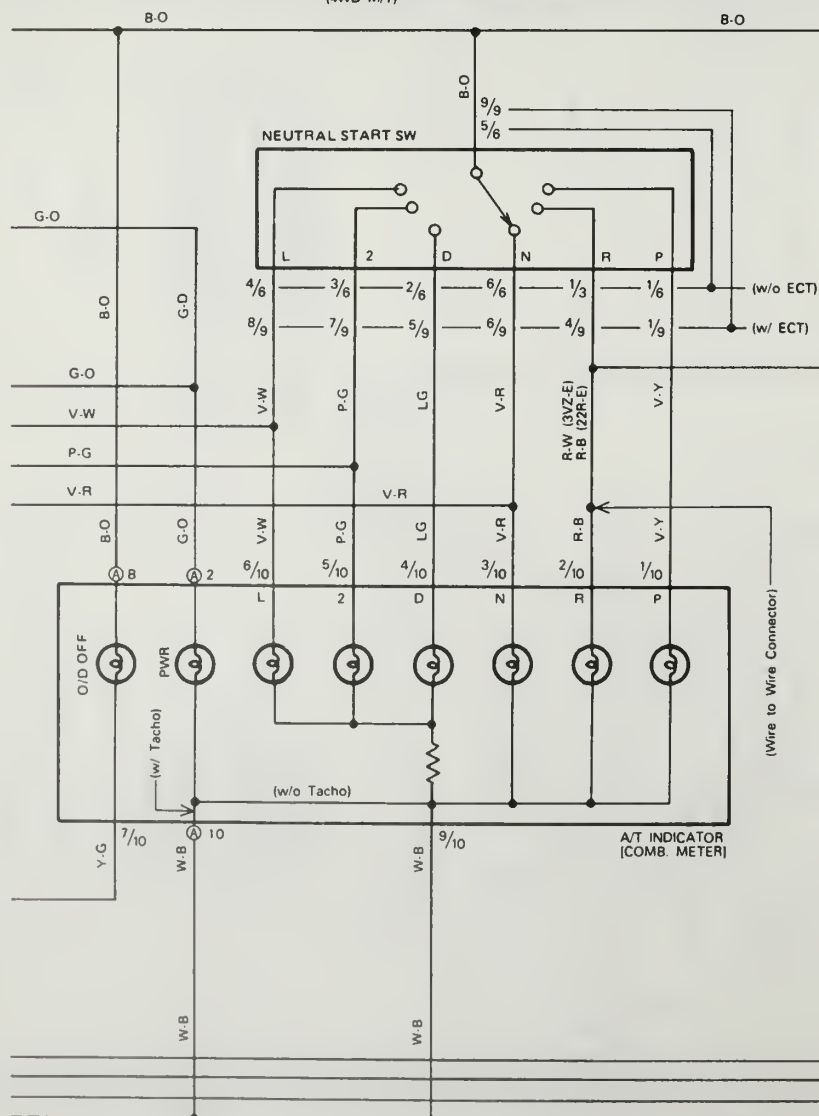
Automatic Transmission Indicator

6

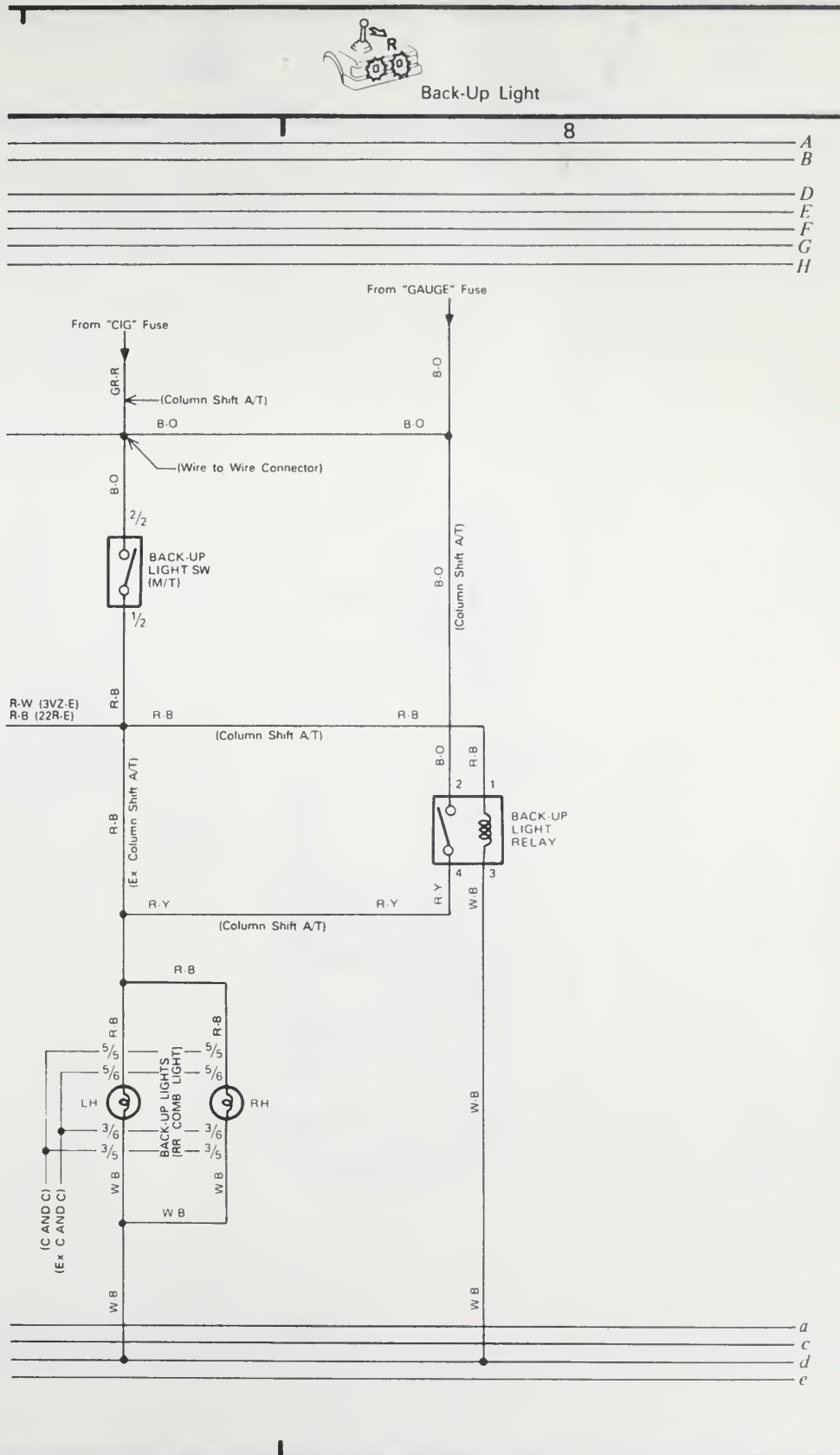
7

E01	#10	STA	STJ	NSW	FPU	W	T	IDL	IGF	OX2	THG	KNK	NE	HT2	VC	VS	THA	BATT	+B1
E02	#20	IGT	E1	VF		AS	EGR	HT1	E2	OX1	VCC	VTA	THW	OD1	E21		SPD	STP	+B

(4WD M/T)

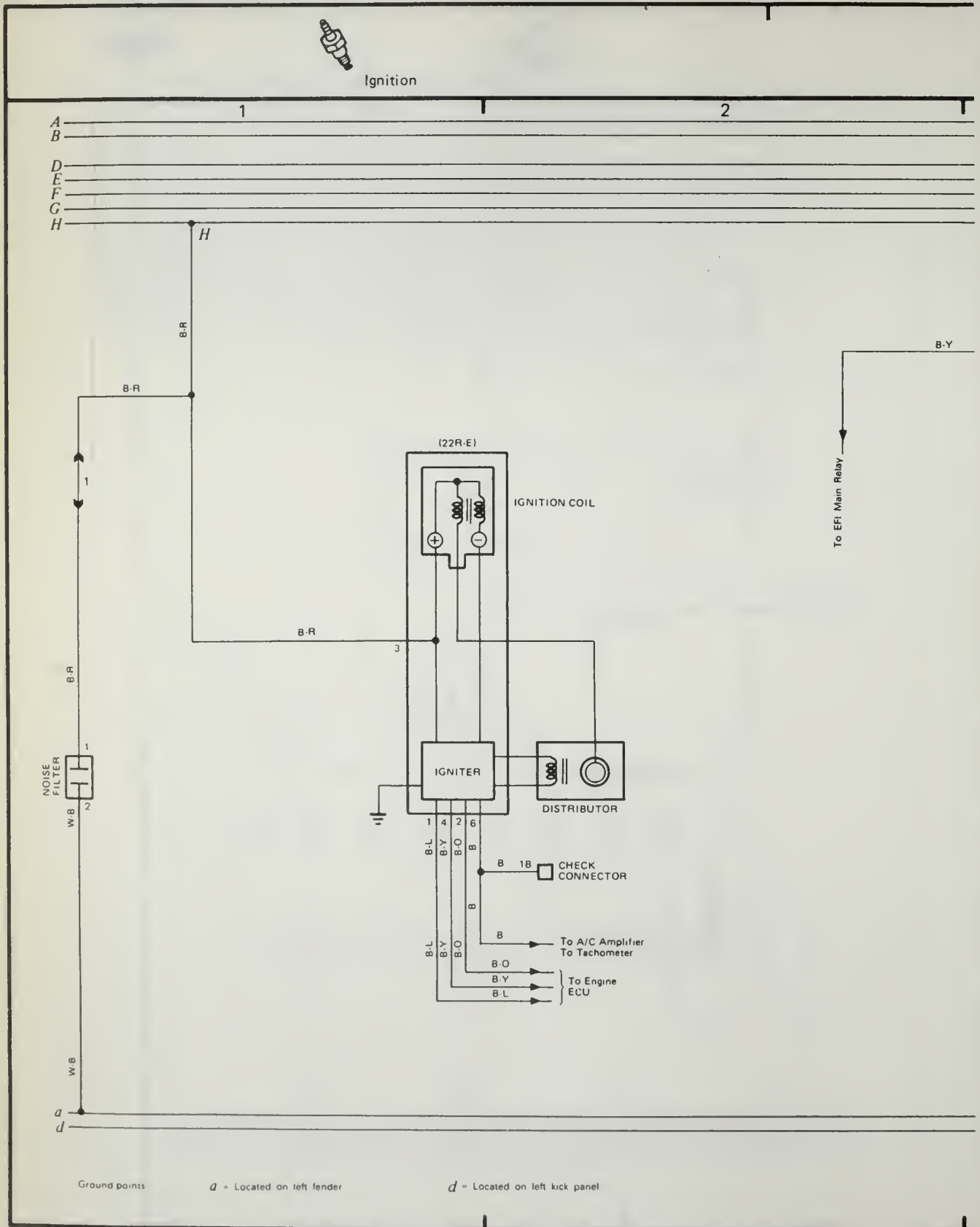


Wiring diagram – 1991 truck

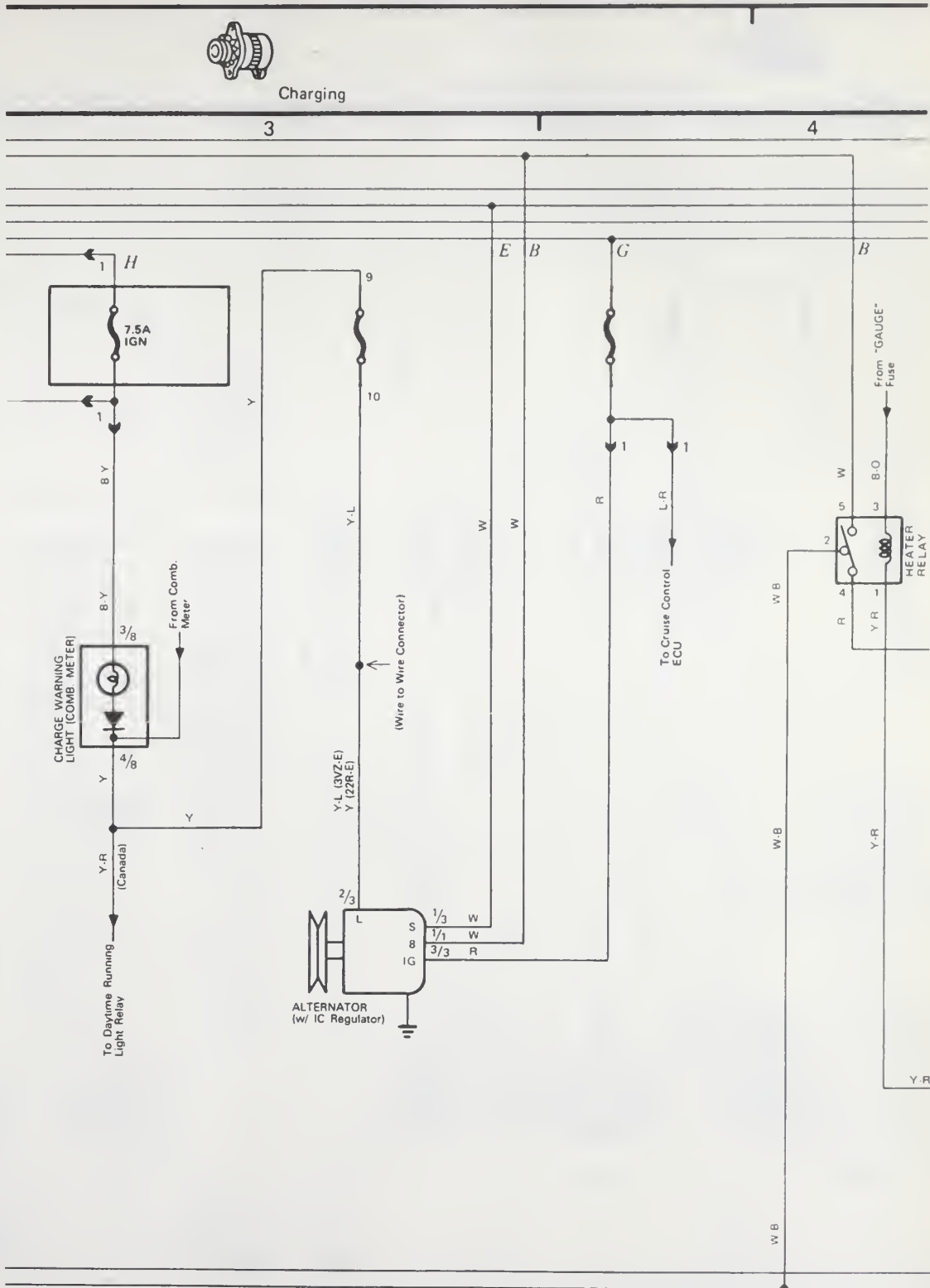


Wiring diagram — 1991 truck

6 CHASSIS ELECTRICAL



Wiring diagram – 1991 truck

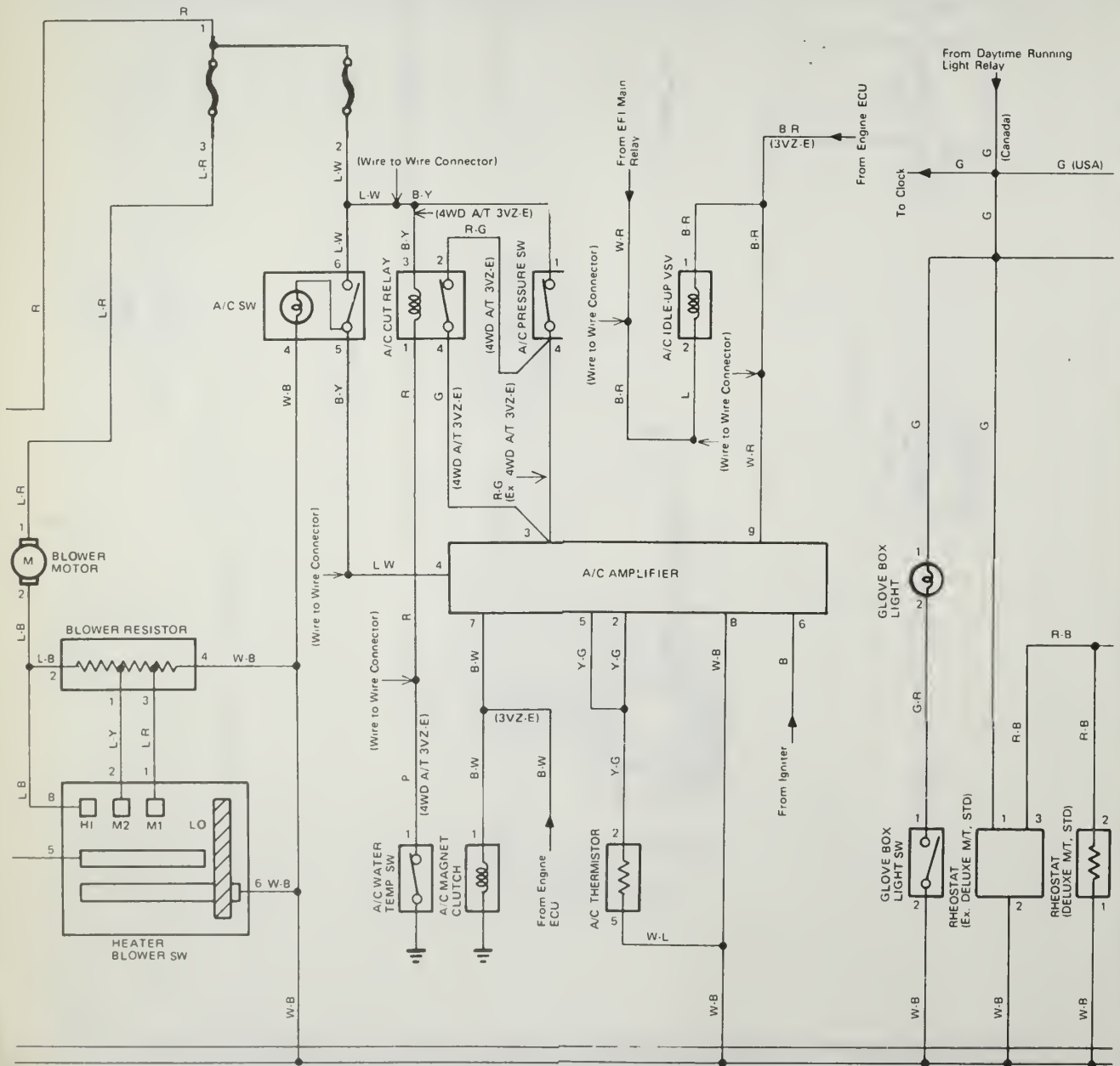


Wiring diagram — 1991 truck

6 CHASSIS ELECTRICAL

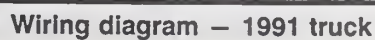


Air Conditioner, Cooler and Heater

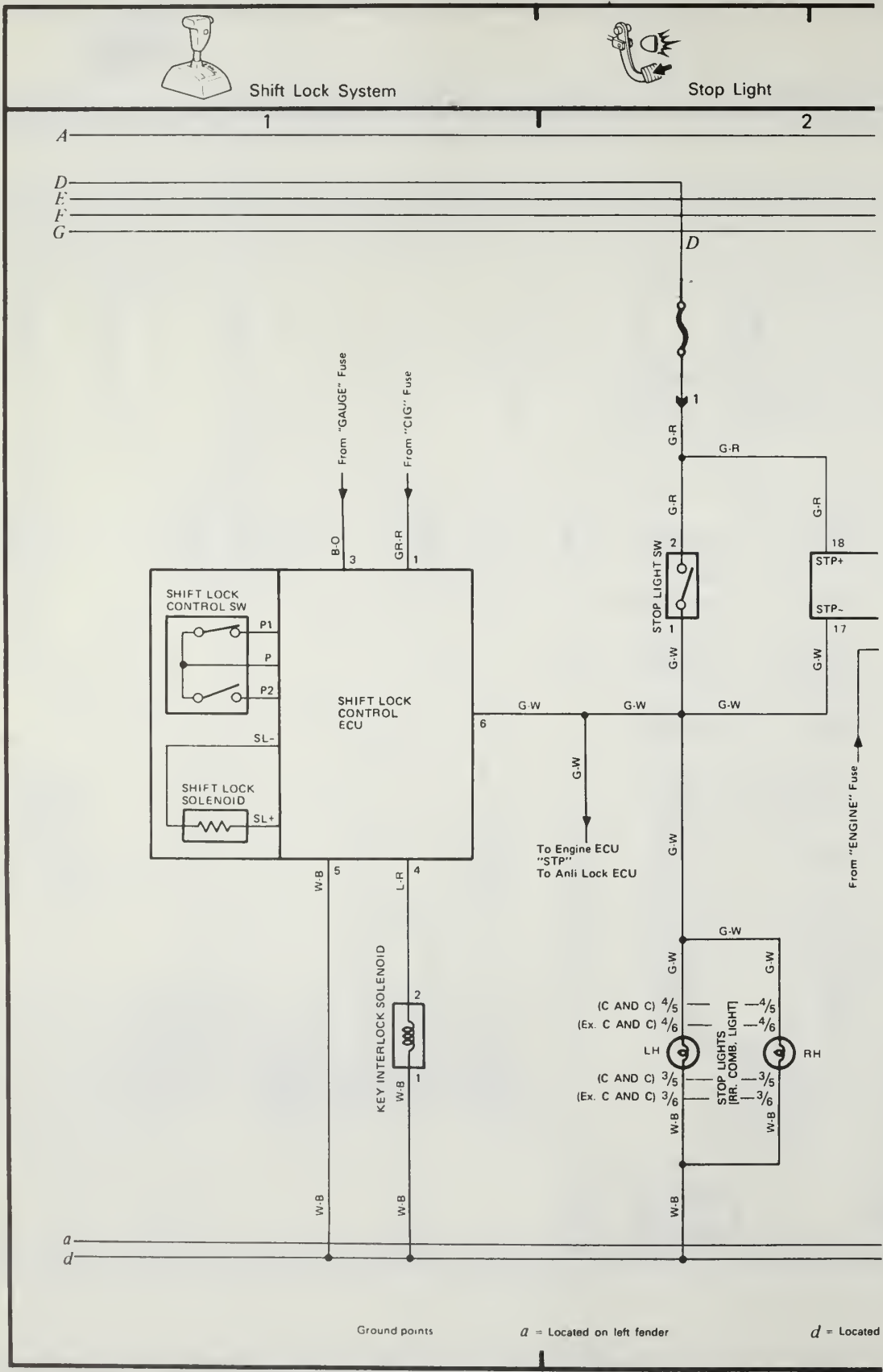


Wiring diagram — 1991 truck

Headlight (USA)



6 CHASSIS ELECTRICAL



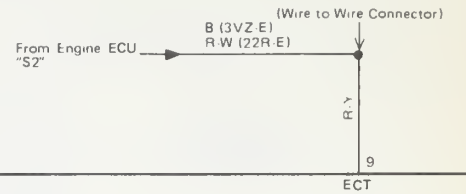
Wiring diagram – 1991 truck



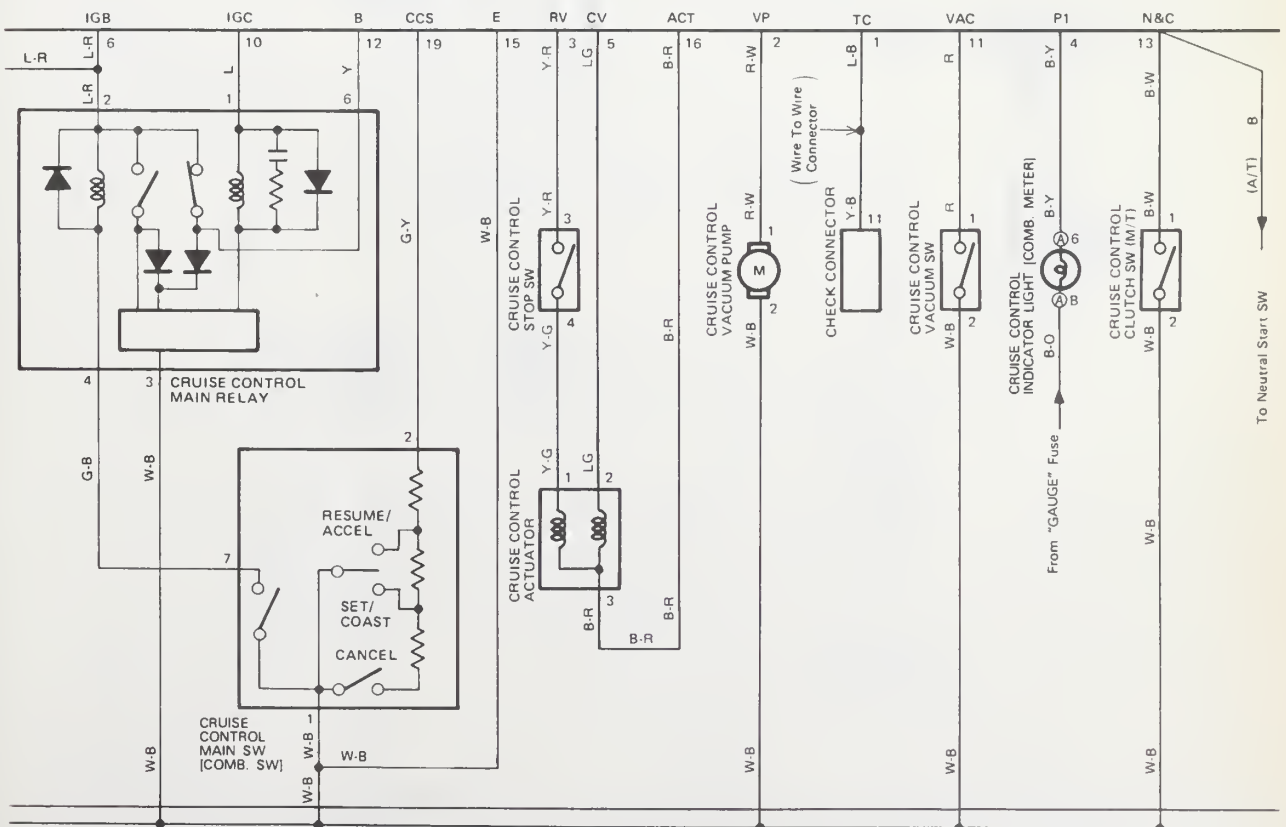
Cruise Control

3

4



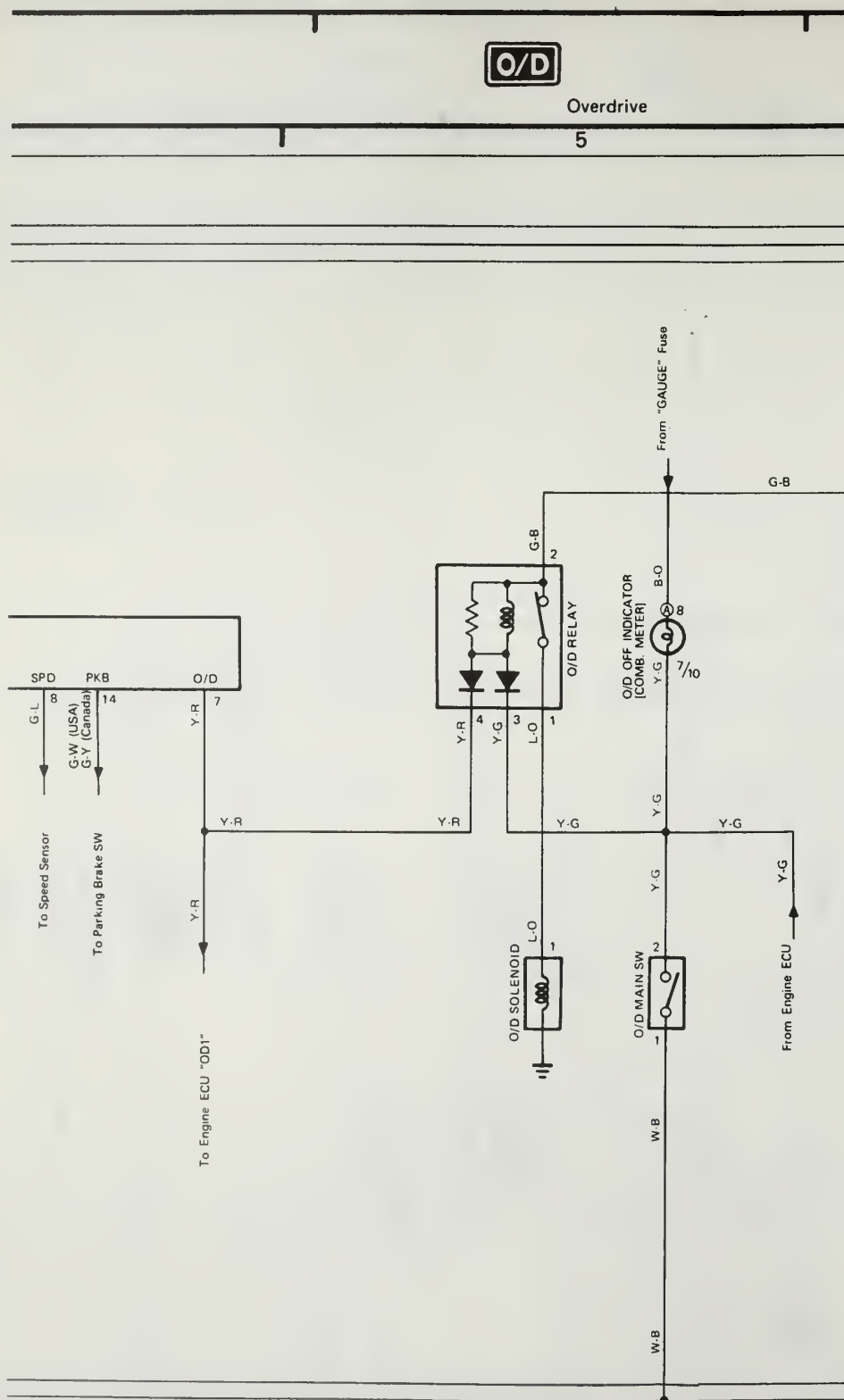
CRUISE CONTROL ECU



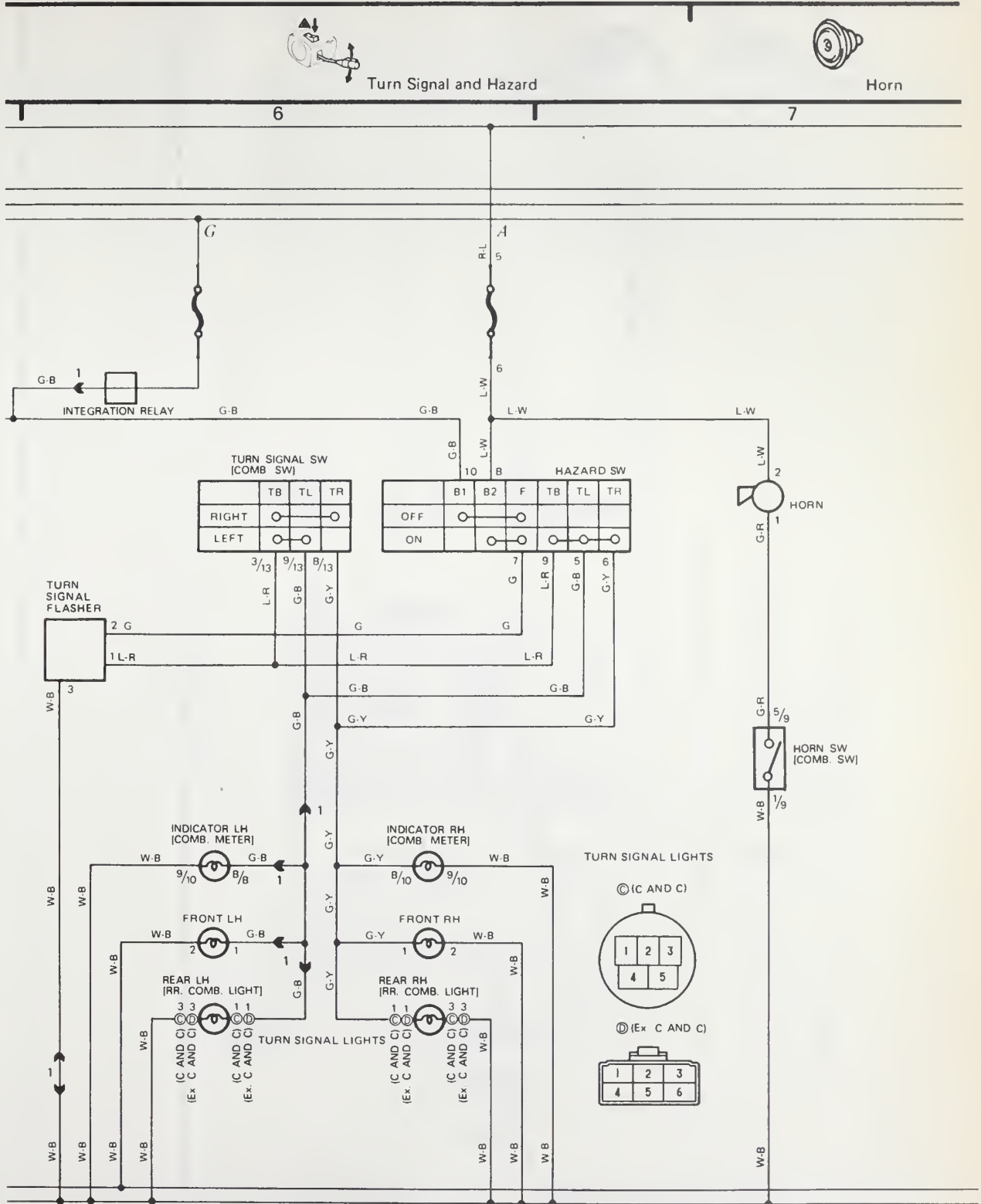
on left kick panel

Wiring diagram – 1991 truck

6 CHASSIS ELECTRICAL

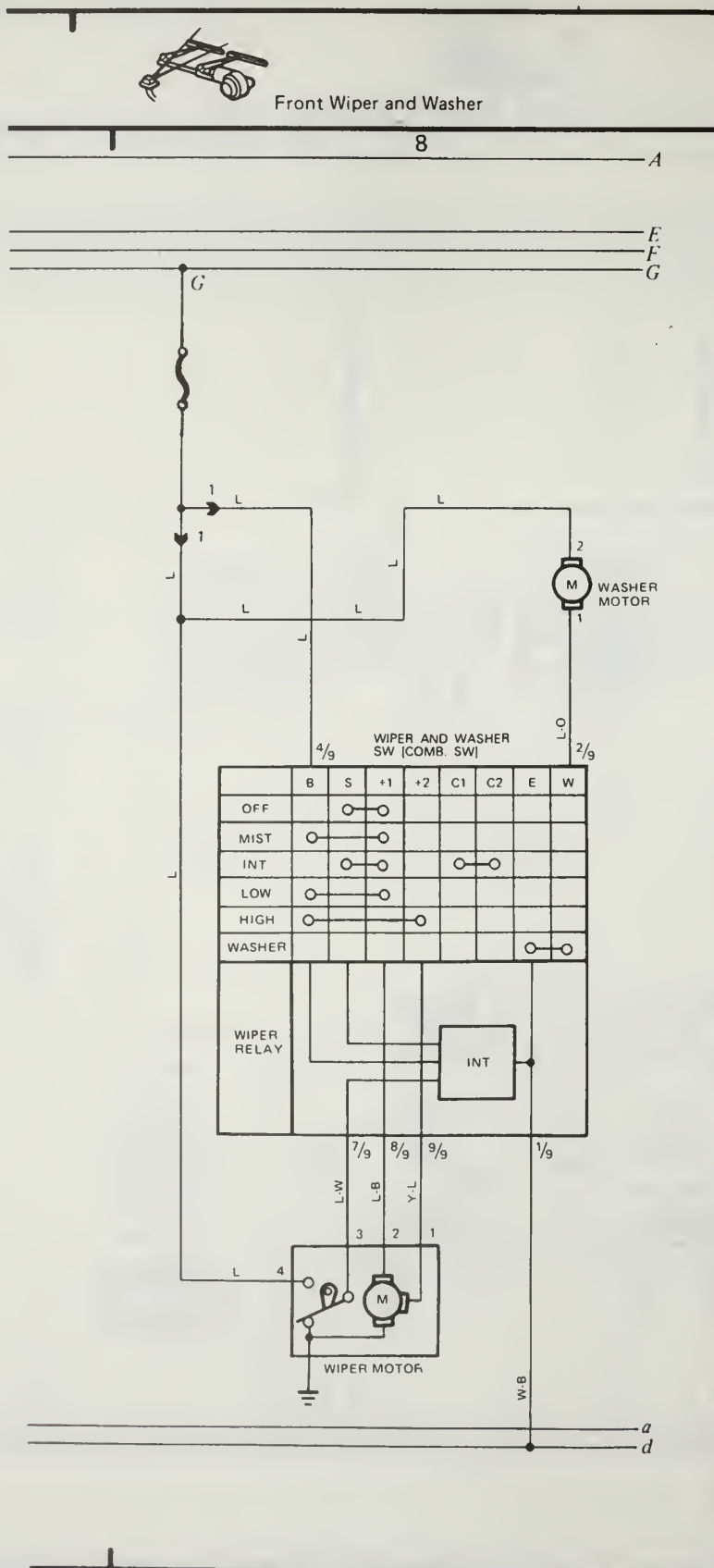


Wiring diagram — 1991 truck



Wiring diagram — 1991 truck

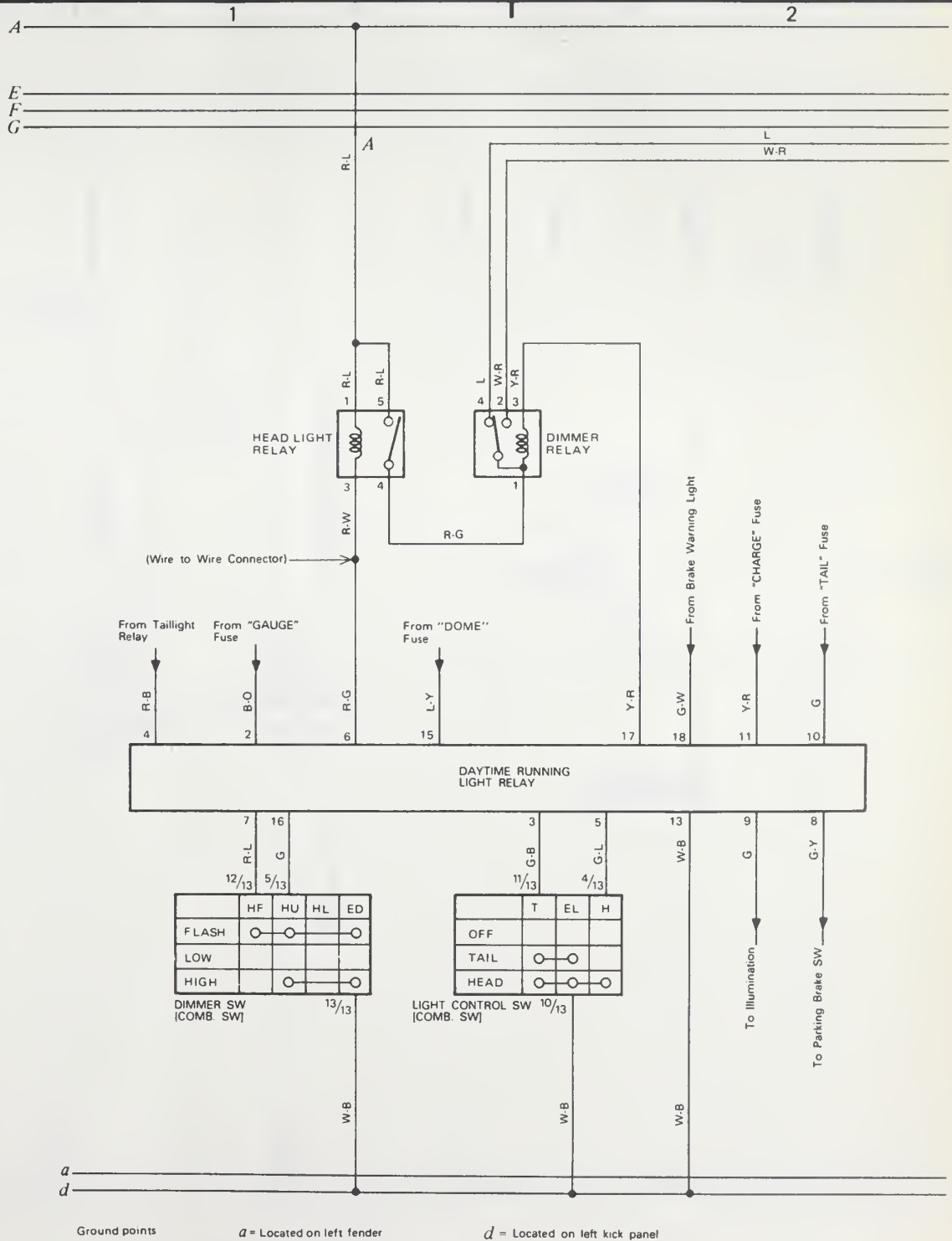
6 CHASSIS ELECTRICAL



Wiring diagram — 1991 truck



Headlight (Canada)



Wiring diagram – 1991 truck

6 CHASSIS ELECTRICAL



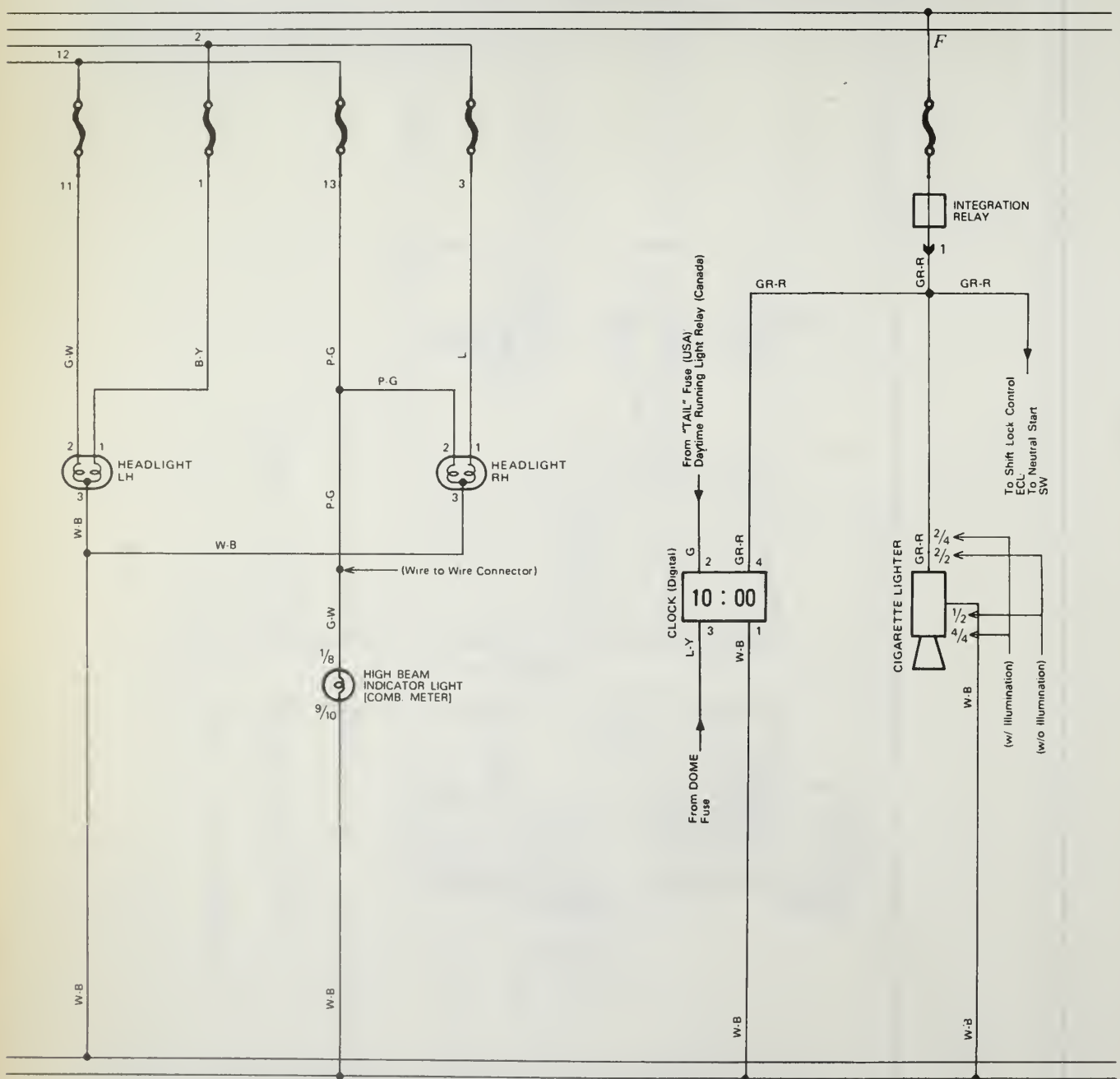
Clock



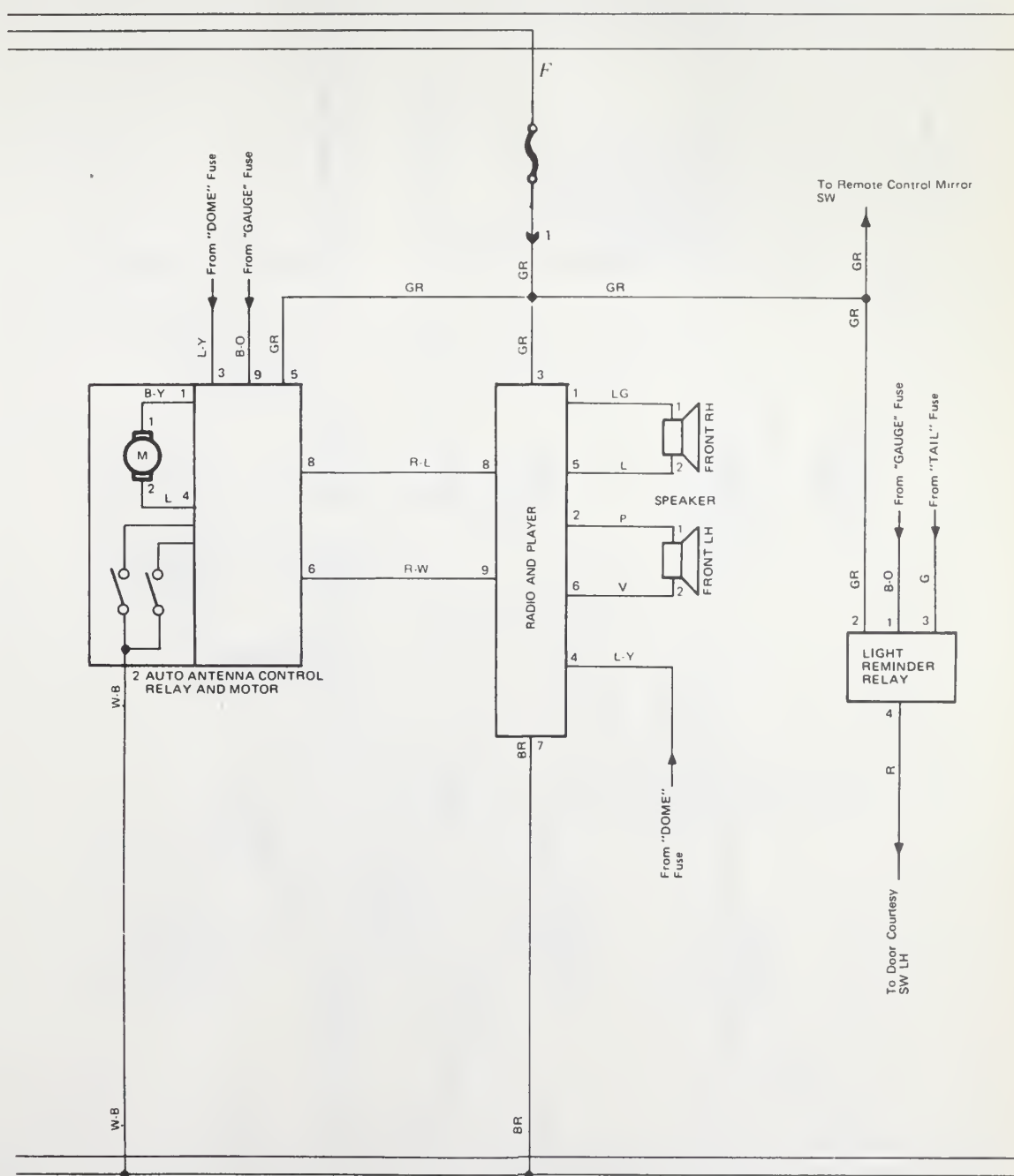
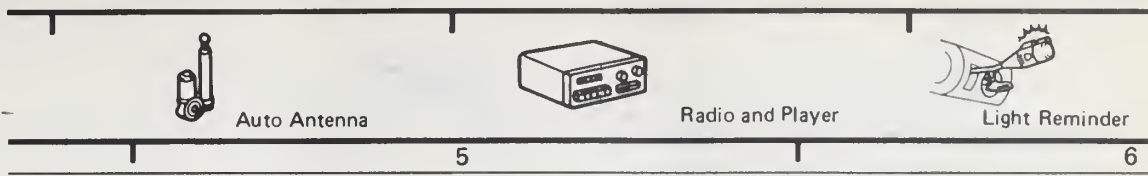
Cigarette Lighter

3

4

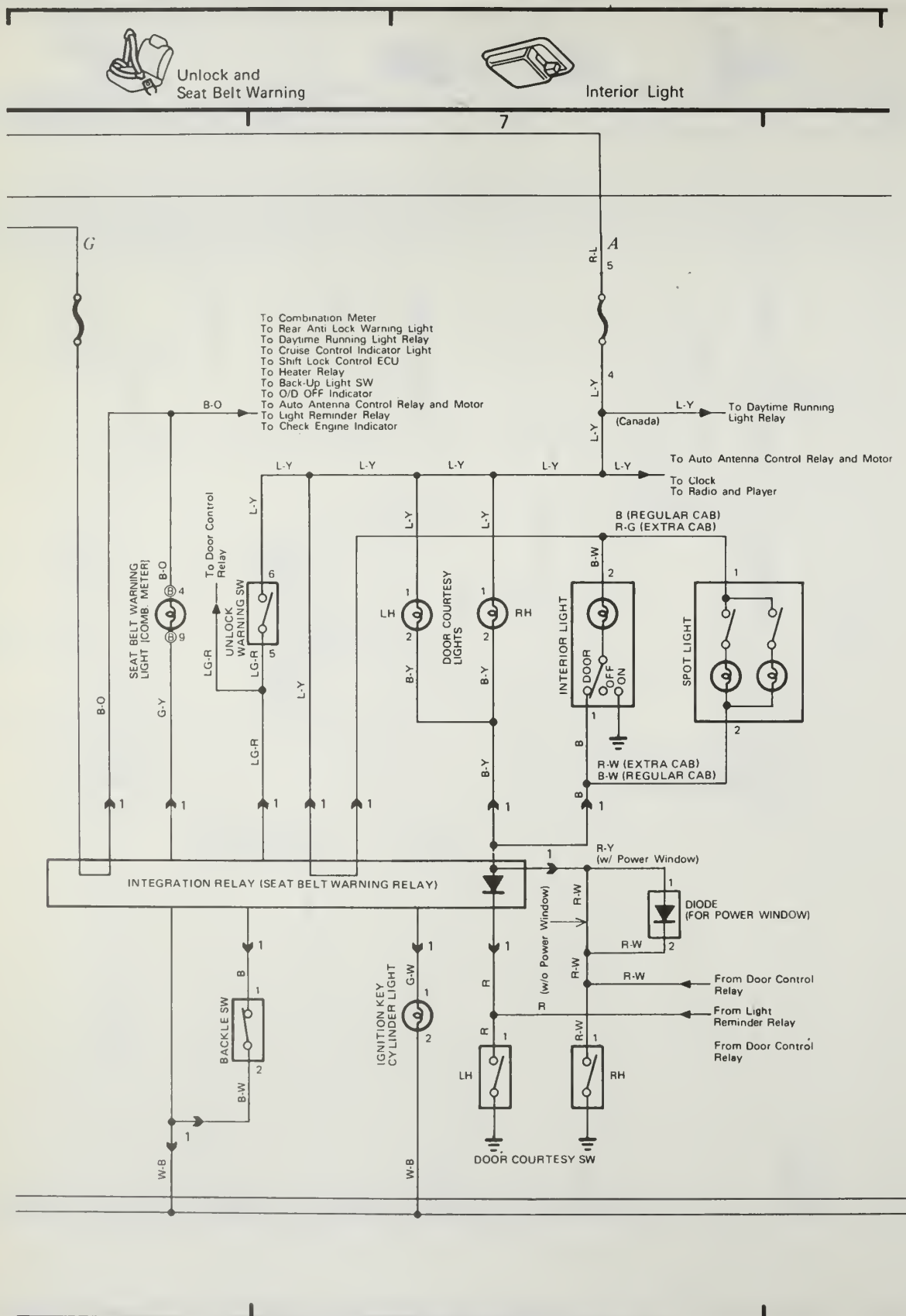


Wiring diagram — 1991 truck

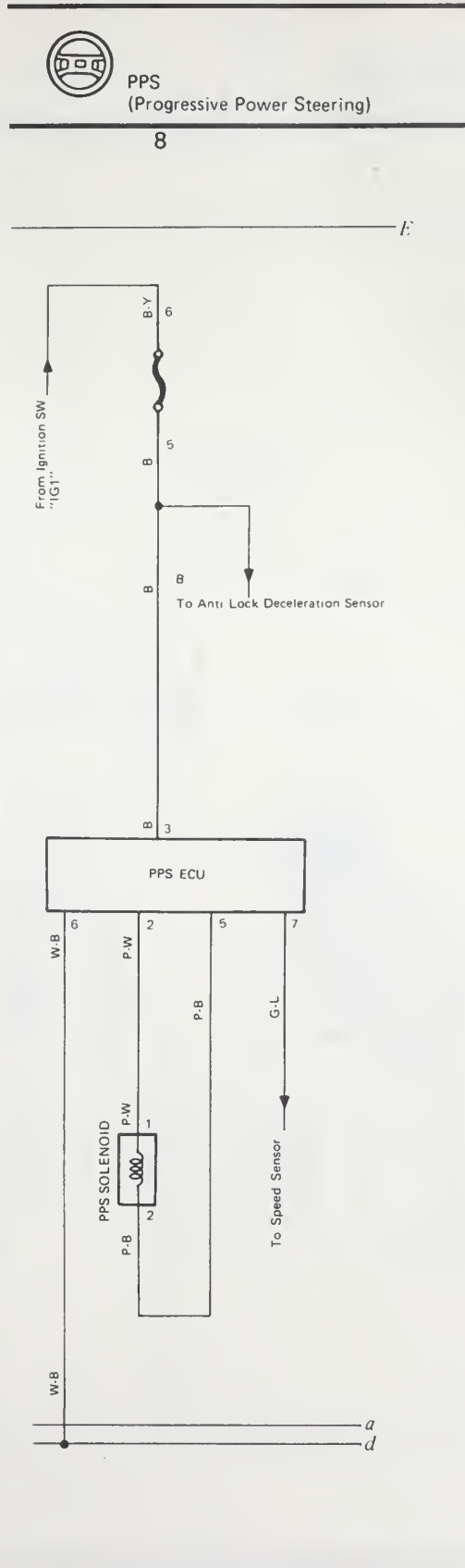


Wiring diagram — 1991 truck

6 CHASSIS ELECTRICAL

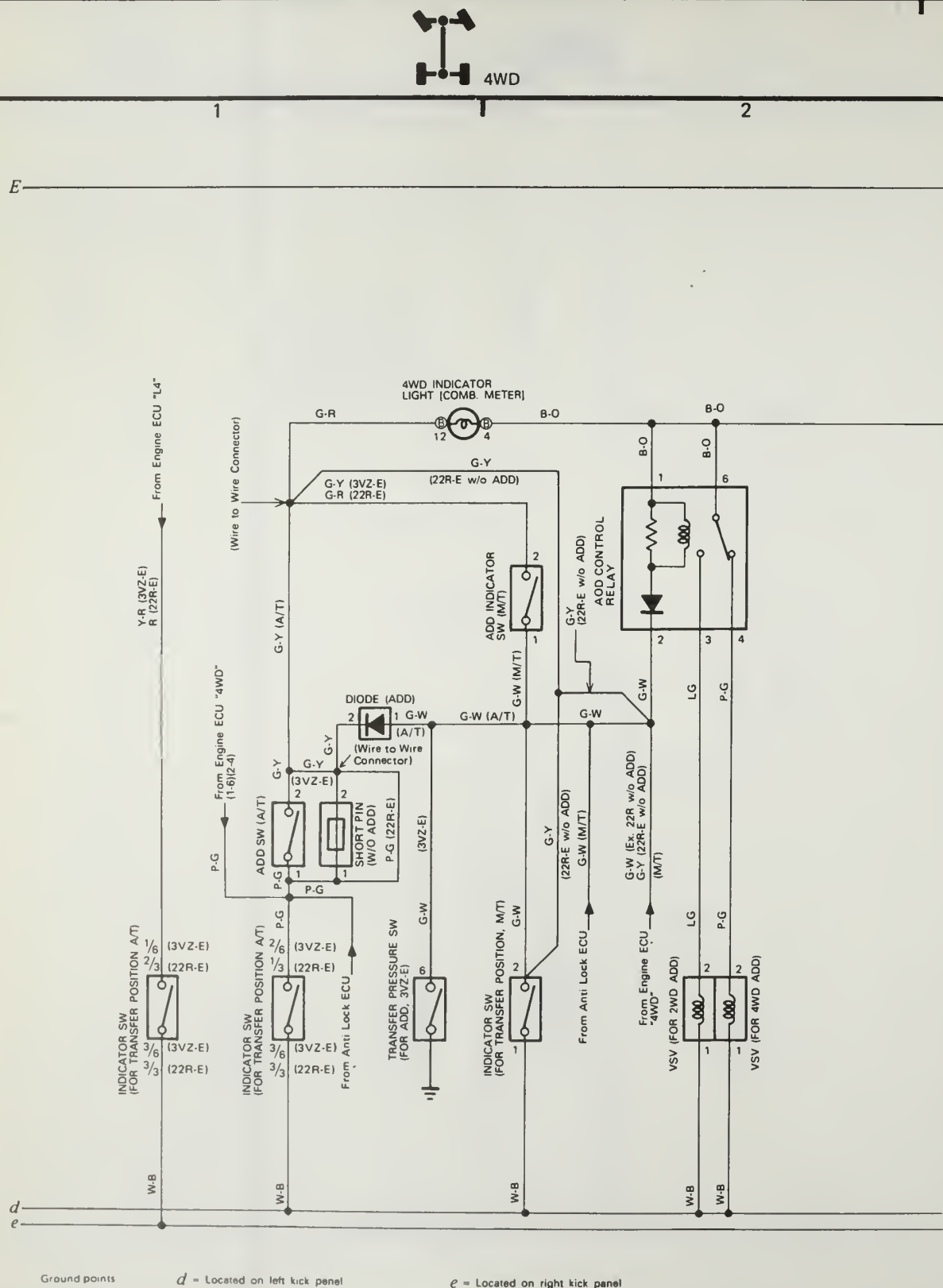


Wiring diagram — 1991 truck



Wiring diagram – 1991 truck

6 CHASSIS ELECTRICAL

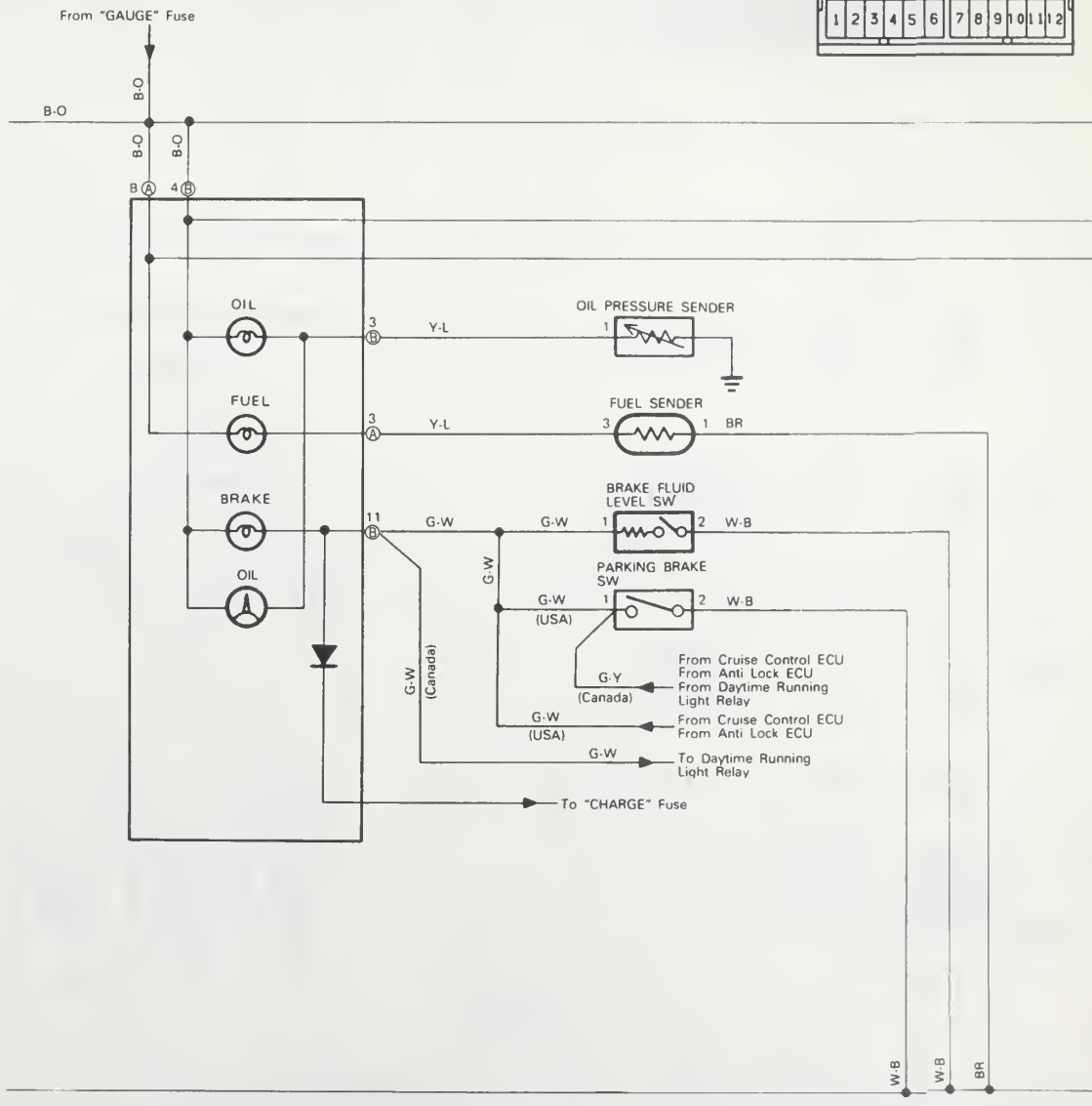


Wiring diagram — 1991 truck



Combination Meter

Ⓐ

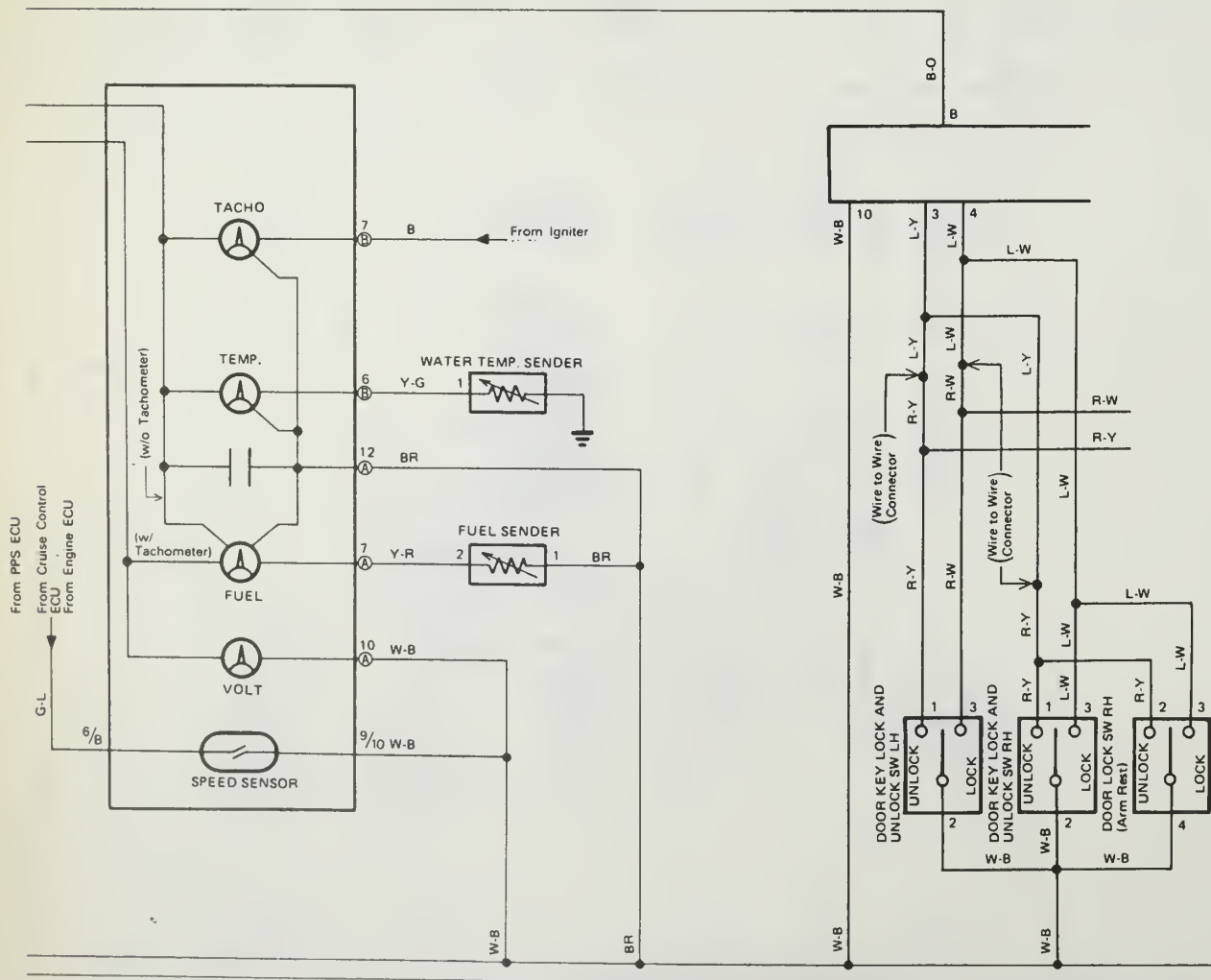
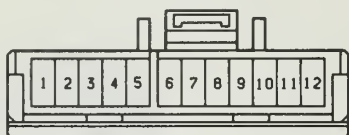


Wiring diagram — 1991 truck

6 CHASSIS ELECTRICAL

5

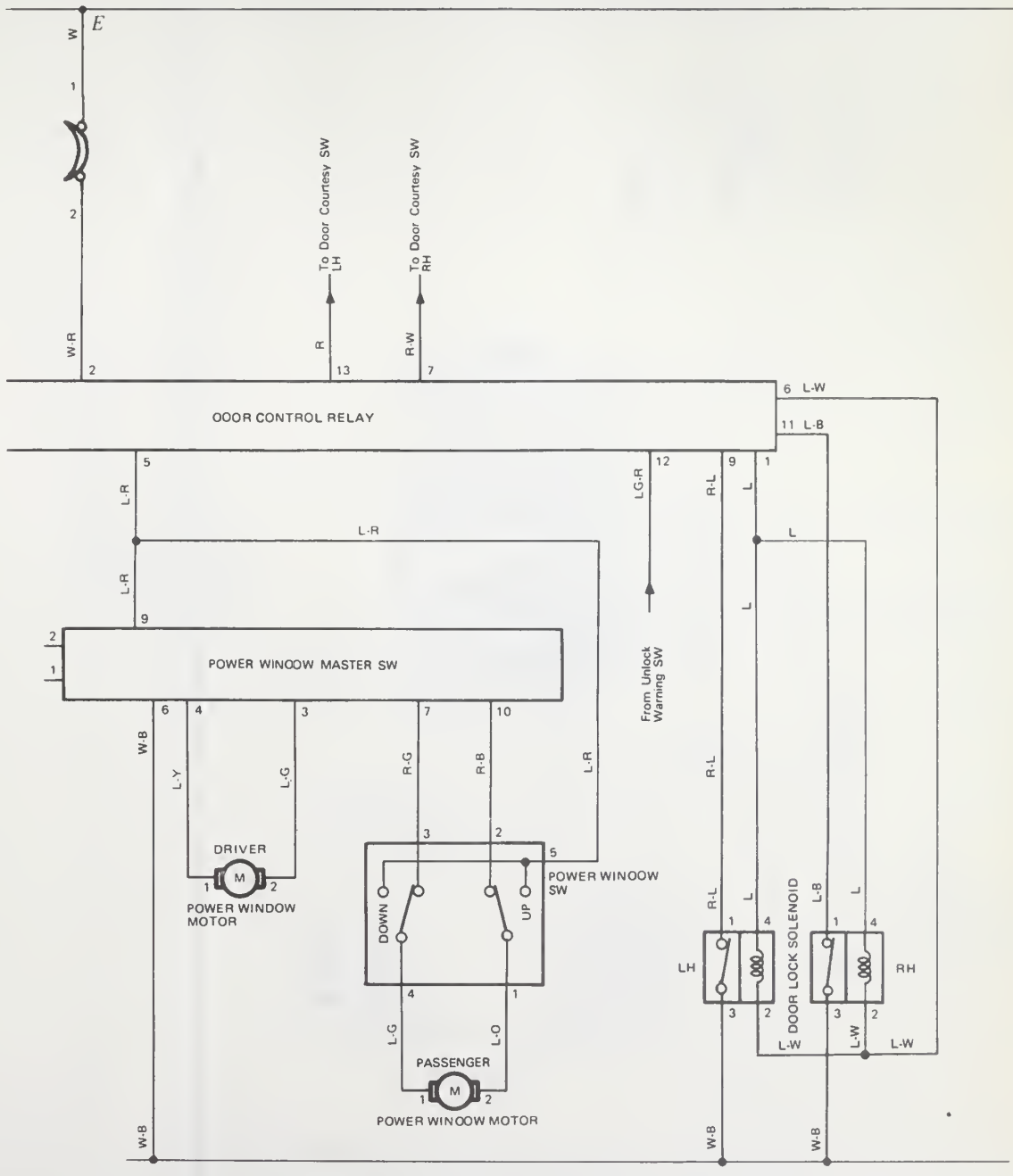
Ⓢ BLUE



Wiring diagram — 1991 truck

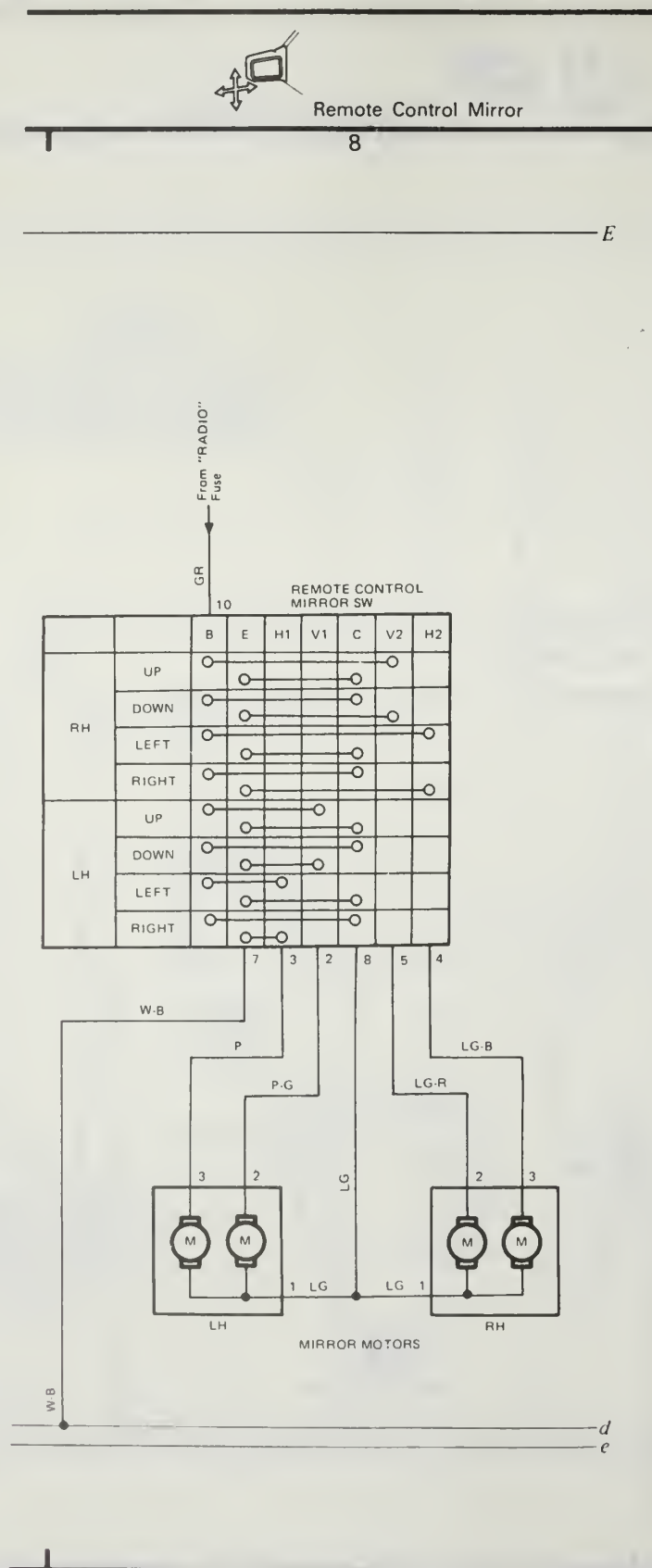


Power Window and Door Lock



Wiring diagram – 1991 truck

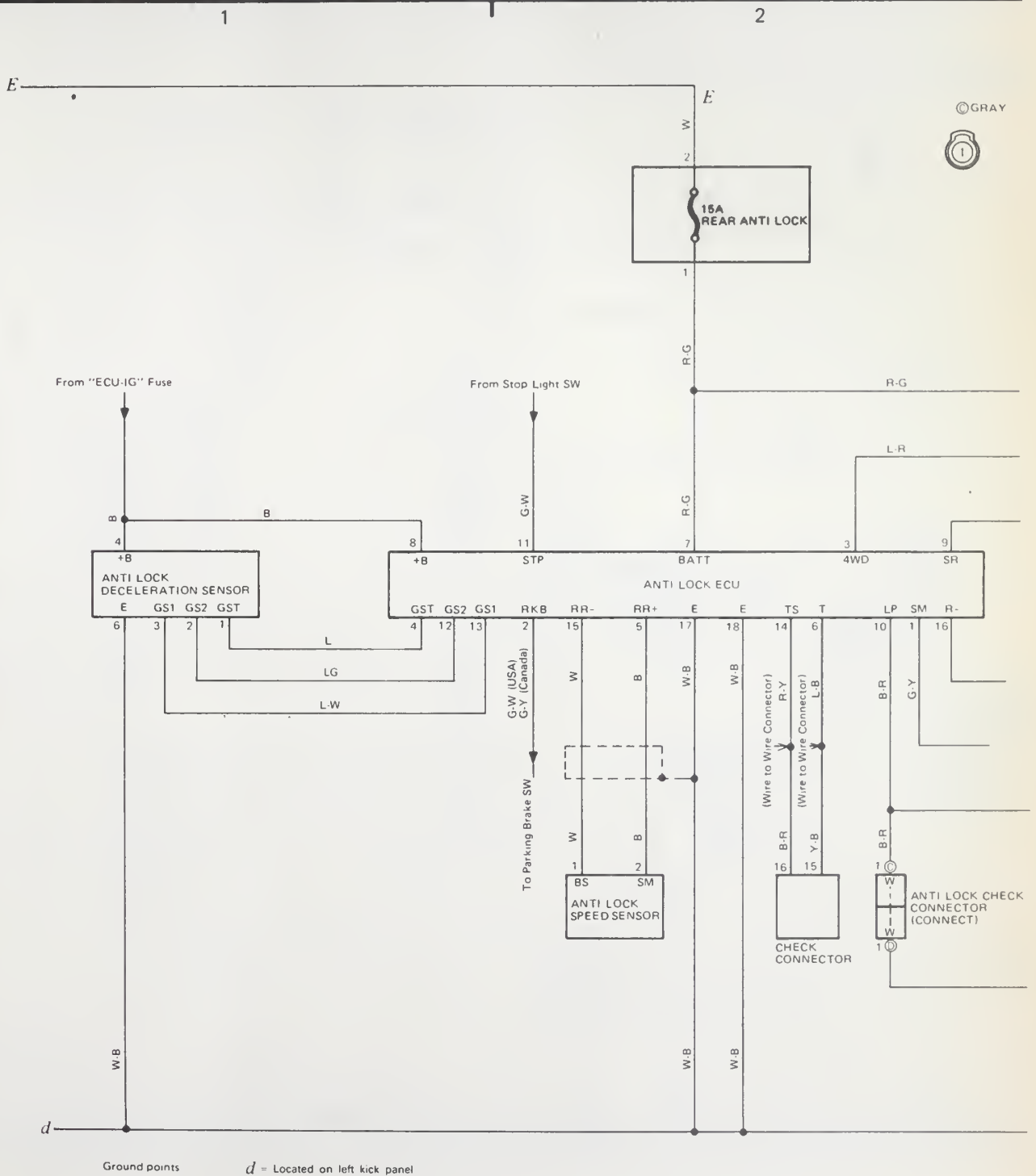
6 CHASSIS ELECTRICAL



Wiring diagram — 1991 truck



Rear Wheel Anti Lock Brake



Wiring diagram – 1991 truck

6 CHASSIS ELECTRICAL

ANTI LOCK CHECK
CONNECTOR
(CONNECT)

① GRAY



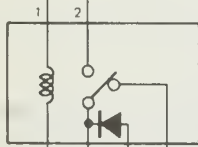
3

4

From "GAUGE" Fuse

P-G (4WD A/T)
G-W (4WD M/T)

R-W



ANTI
LOCK
RELAY

B-O

4

Ⓢ

Ⓢ

B-Ⓢ

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REAR ANTI LOCK
WARNING LIGHT
(COMB. METER)

P-G (4WD A/T)
G-W (4WD M/T)

To Indicator SW (A/T)
To Indicator SW (M/T)

G-B



ANTI
LOCK
ACTUATOR

B-R

B-R

W-B

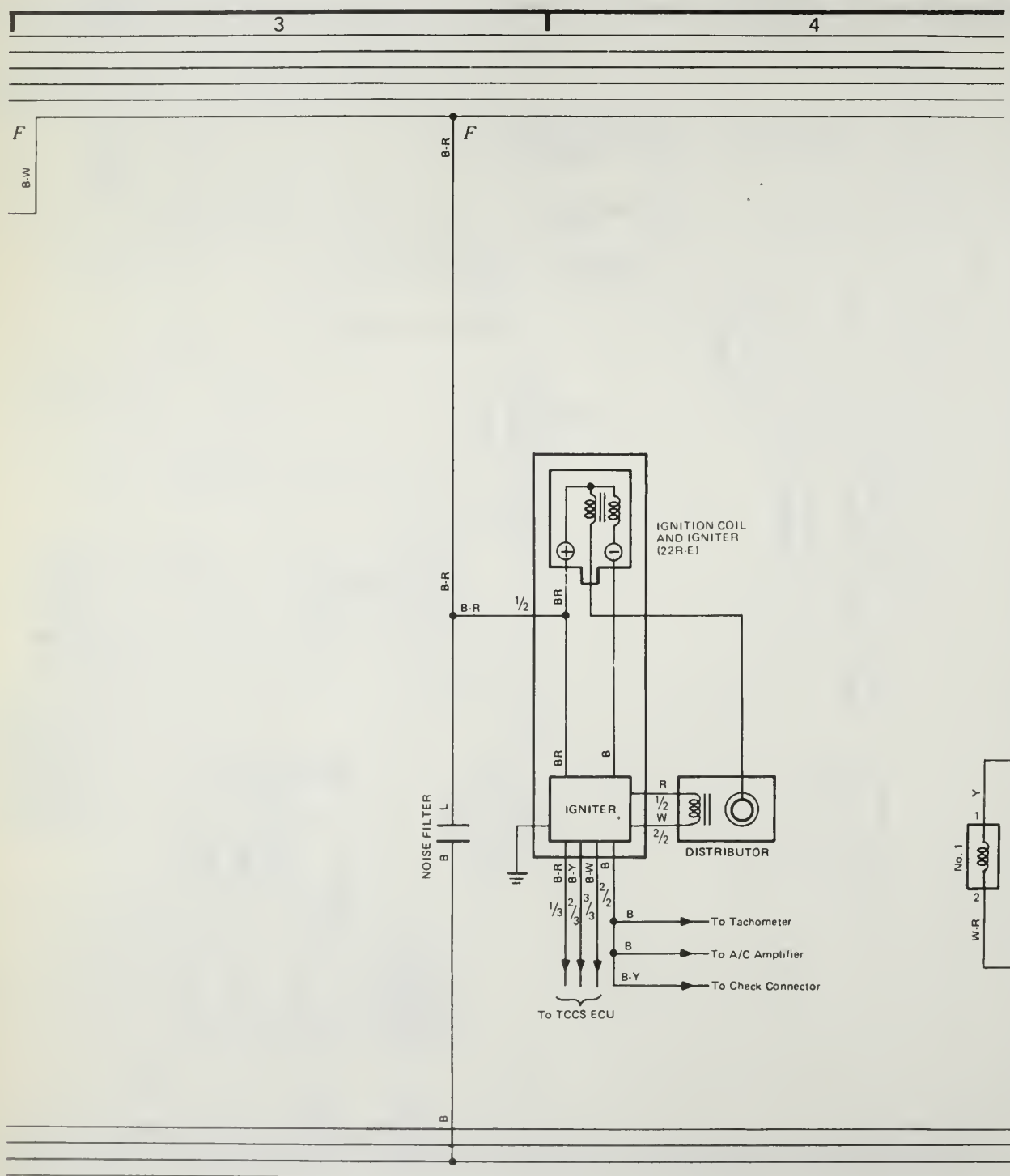
d

Wiring diagram — 1991 truck



6-139

6 CHASSIS ELECTRICAL

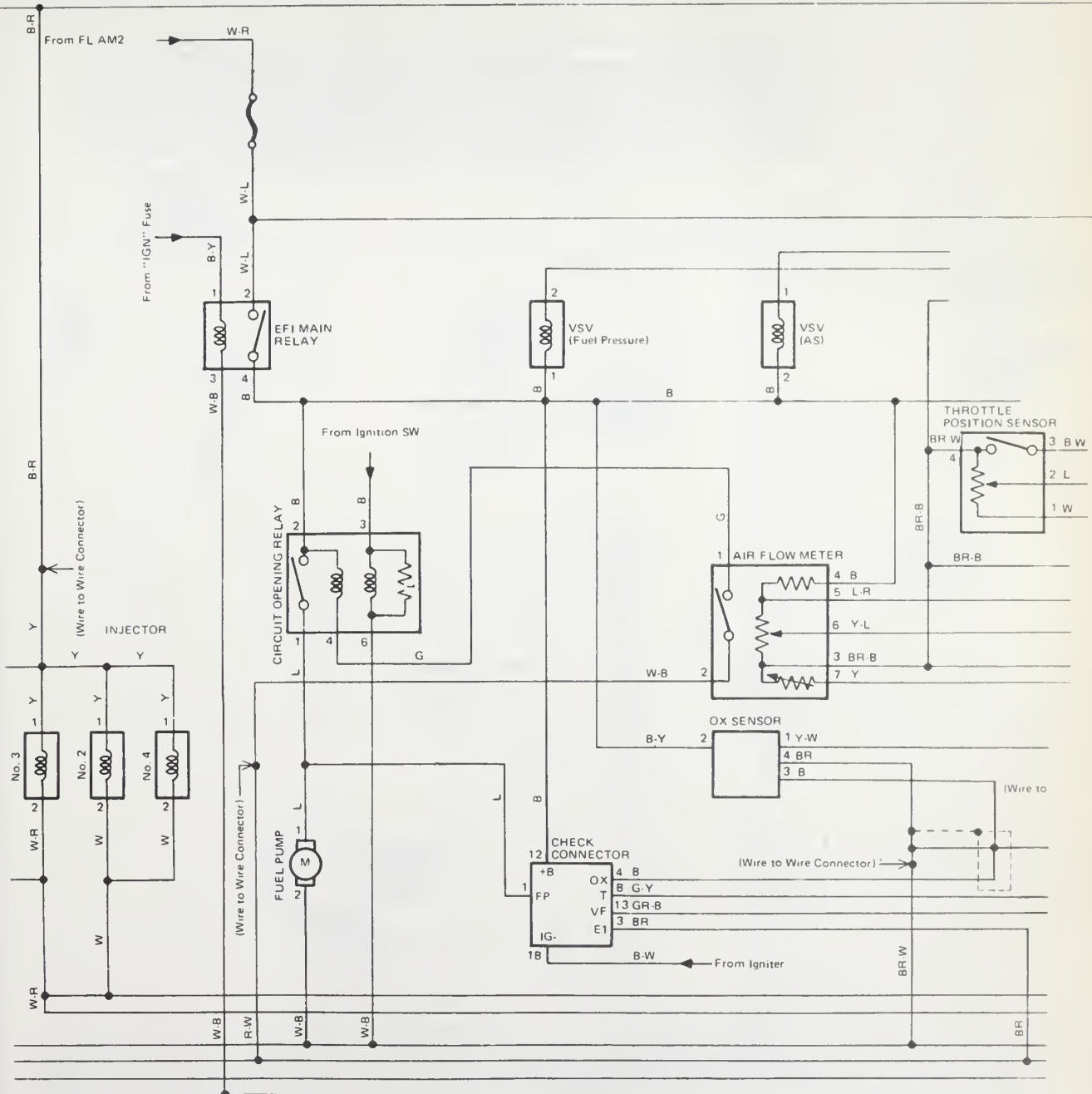


d = Located on rear side panel LH

Wiring diagram — 1989 4Runner

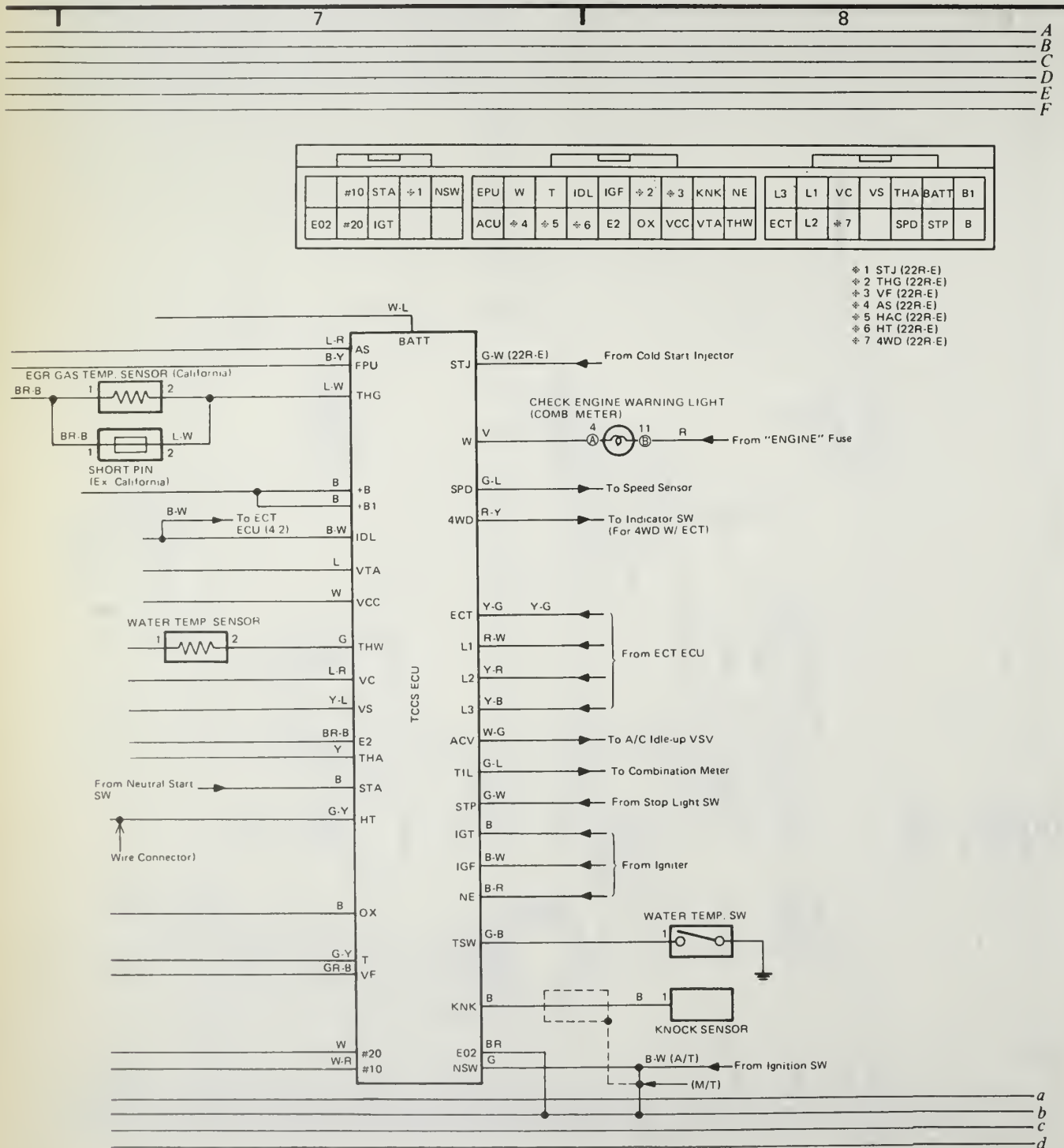
TCCS

TCCS (22R-E)

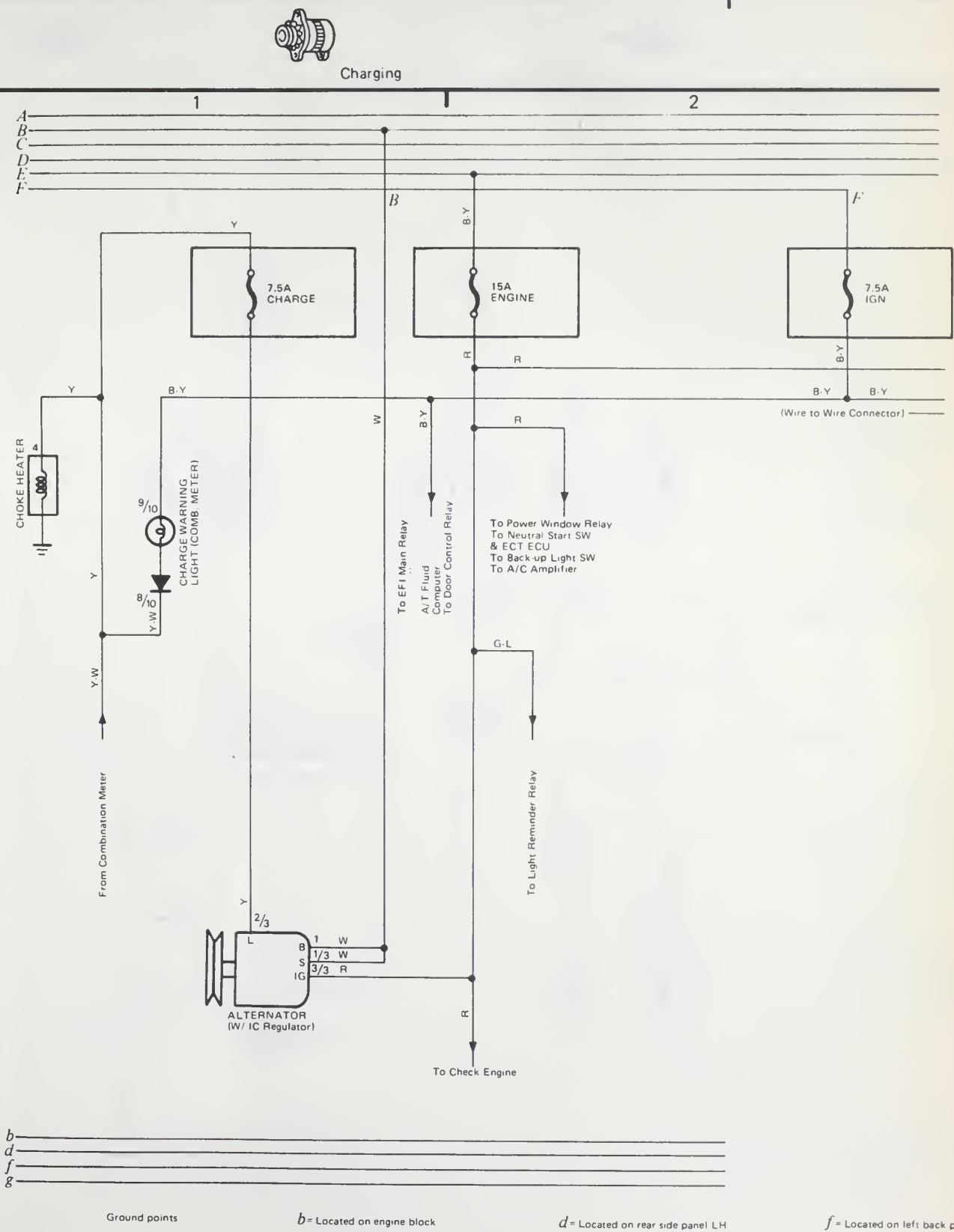


Wiring diagram - 1989 4Runner

6 CHASSIS ELECTRICAL

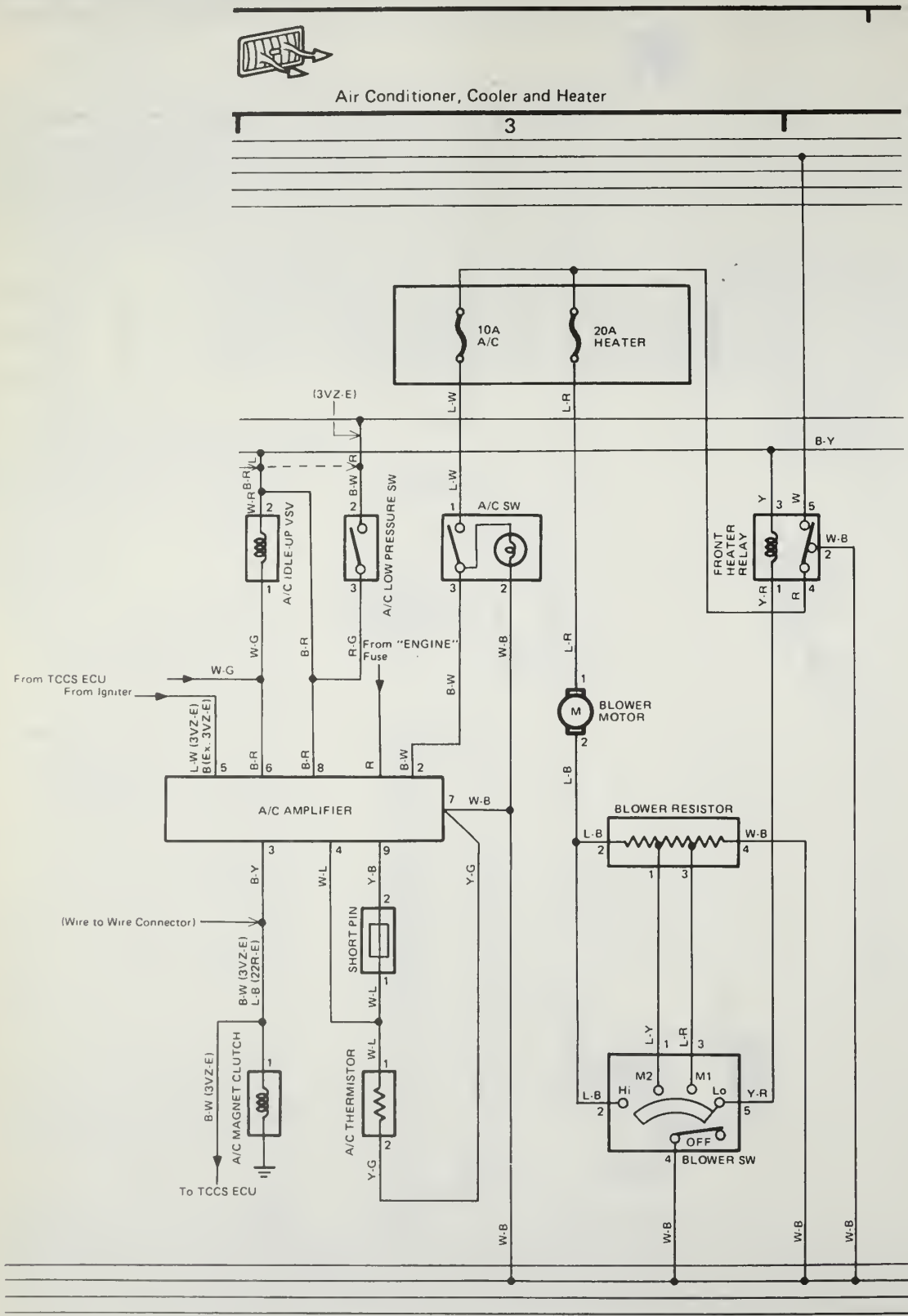


Wiring diagram – 1989 4Runner



Wiring diagram — 1989 4Runner

6 CHASSIS ELECTRICAL



g = Located in left side of instrument panel

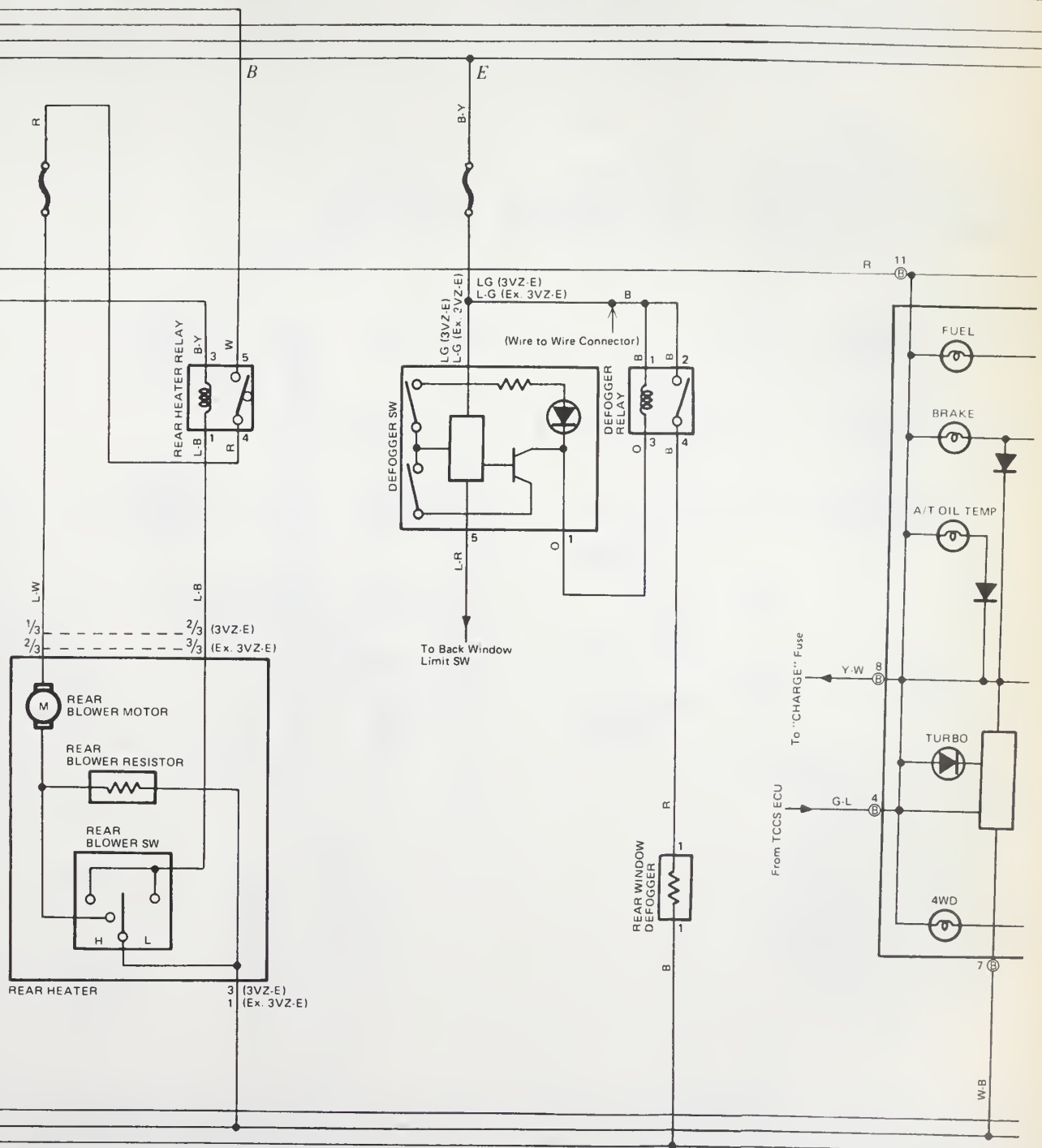
Wiring diagram — 1989 4Runner



Rear Air Conditioner

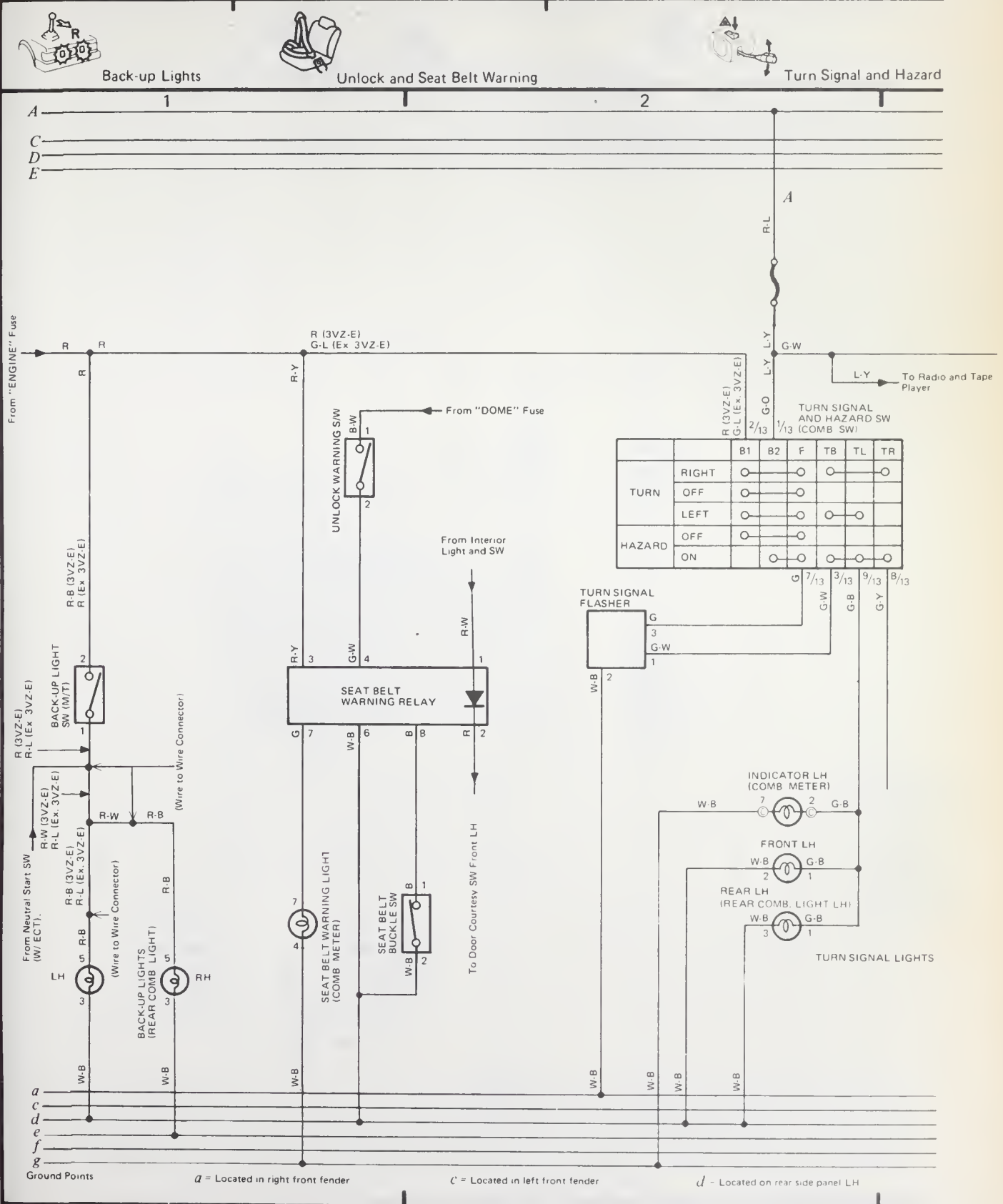


Rear Window Defogger



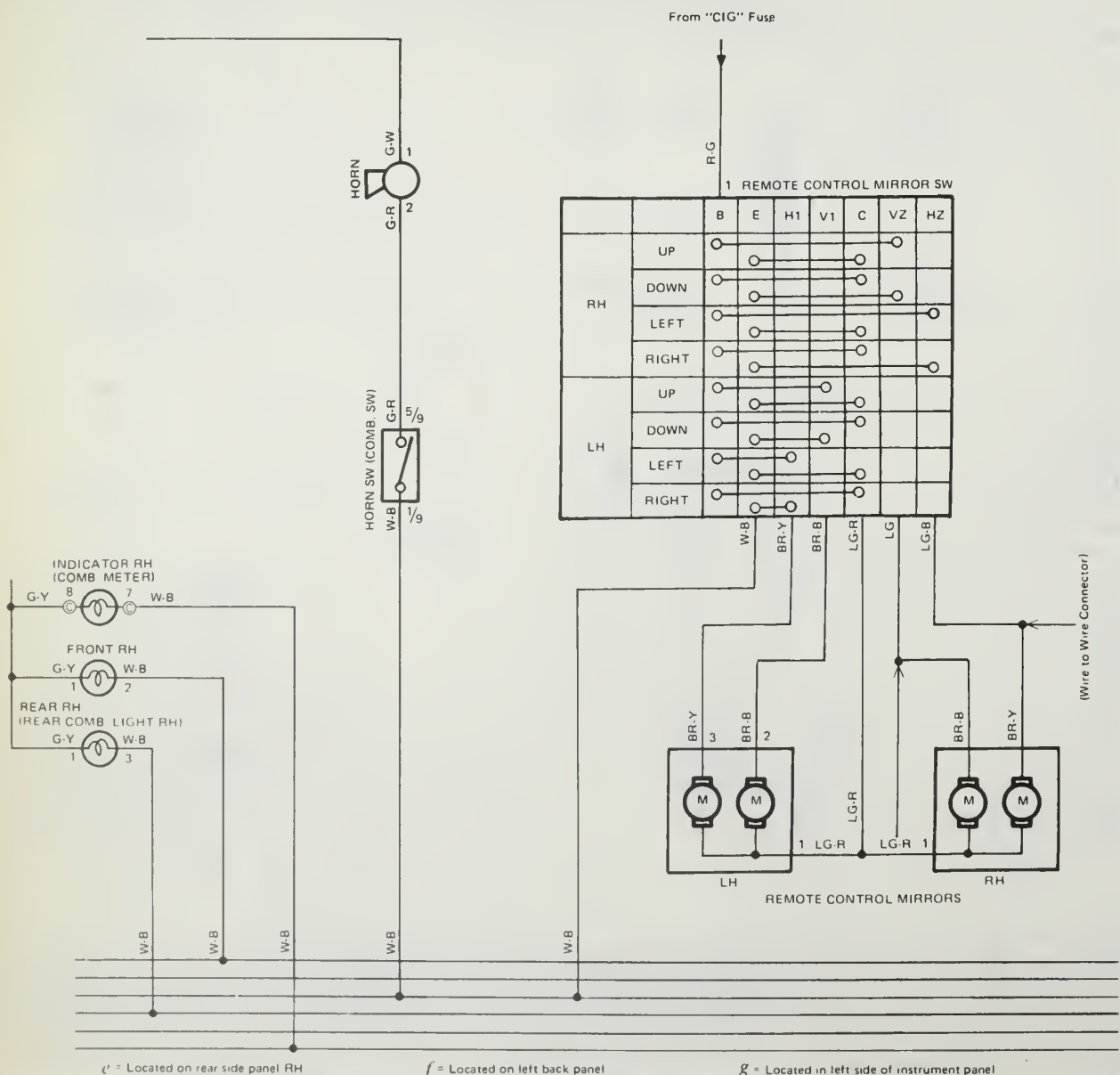
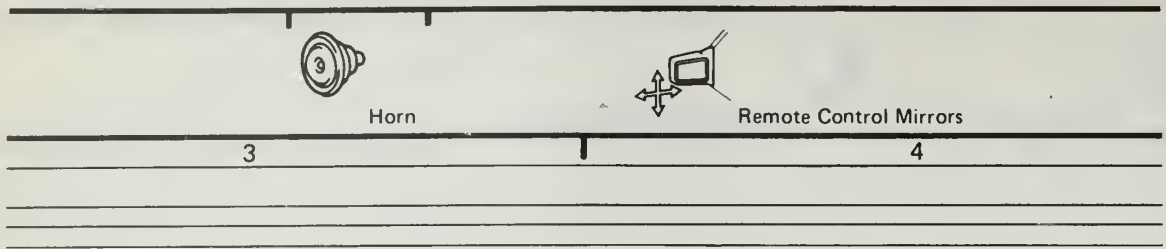
Wiring diagram — 1989 4Runner

6-146



Wiring diagram — 1989 4Runner

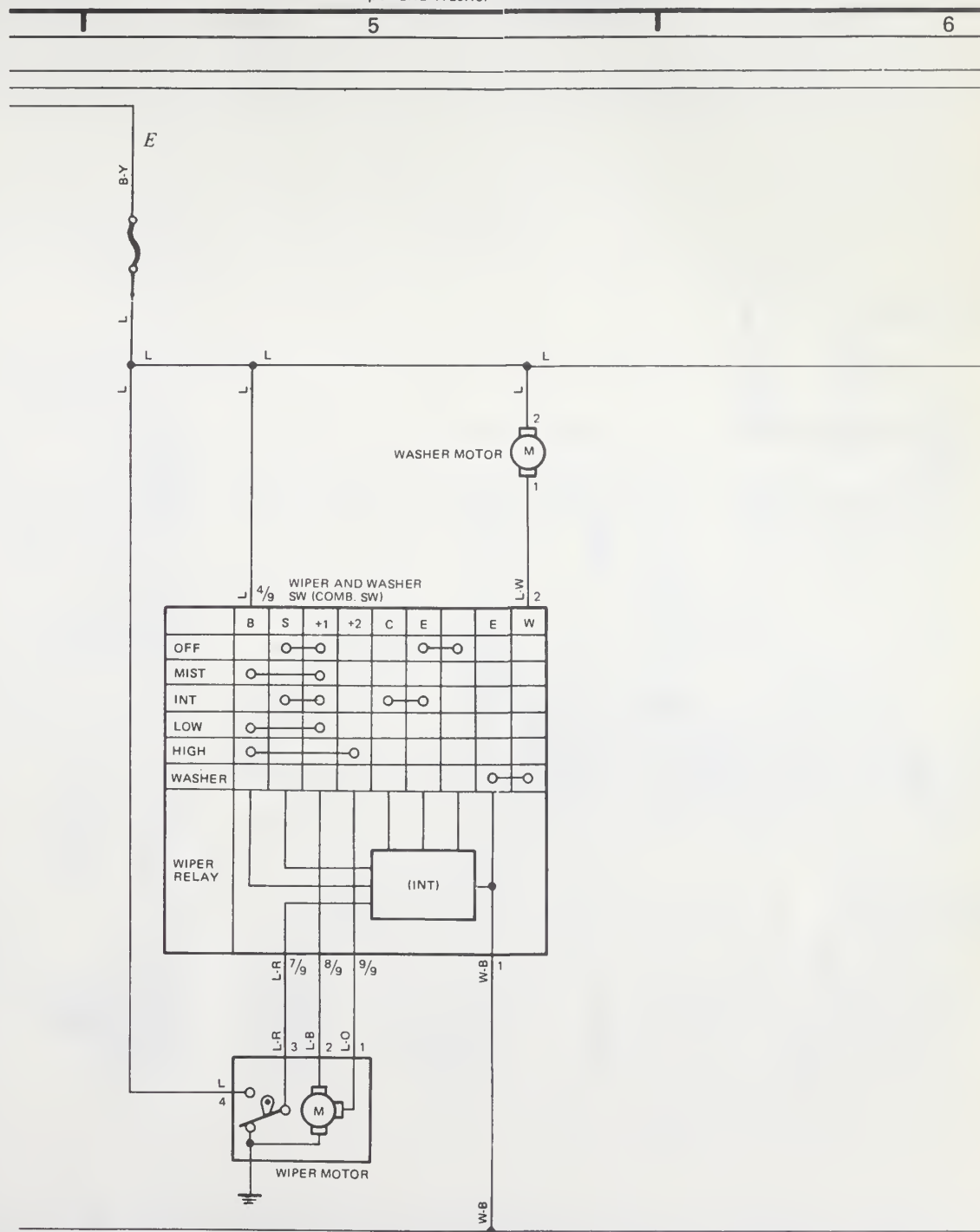
6 CHASSIS ELECTRICAL

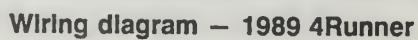


Wiring diagram — 1989 4Runner



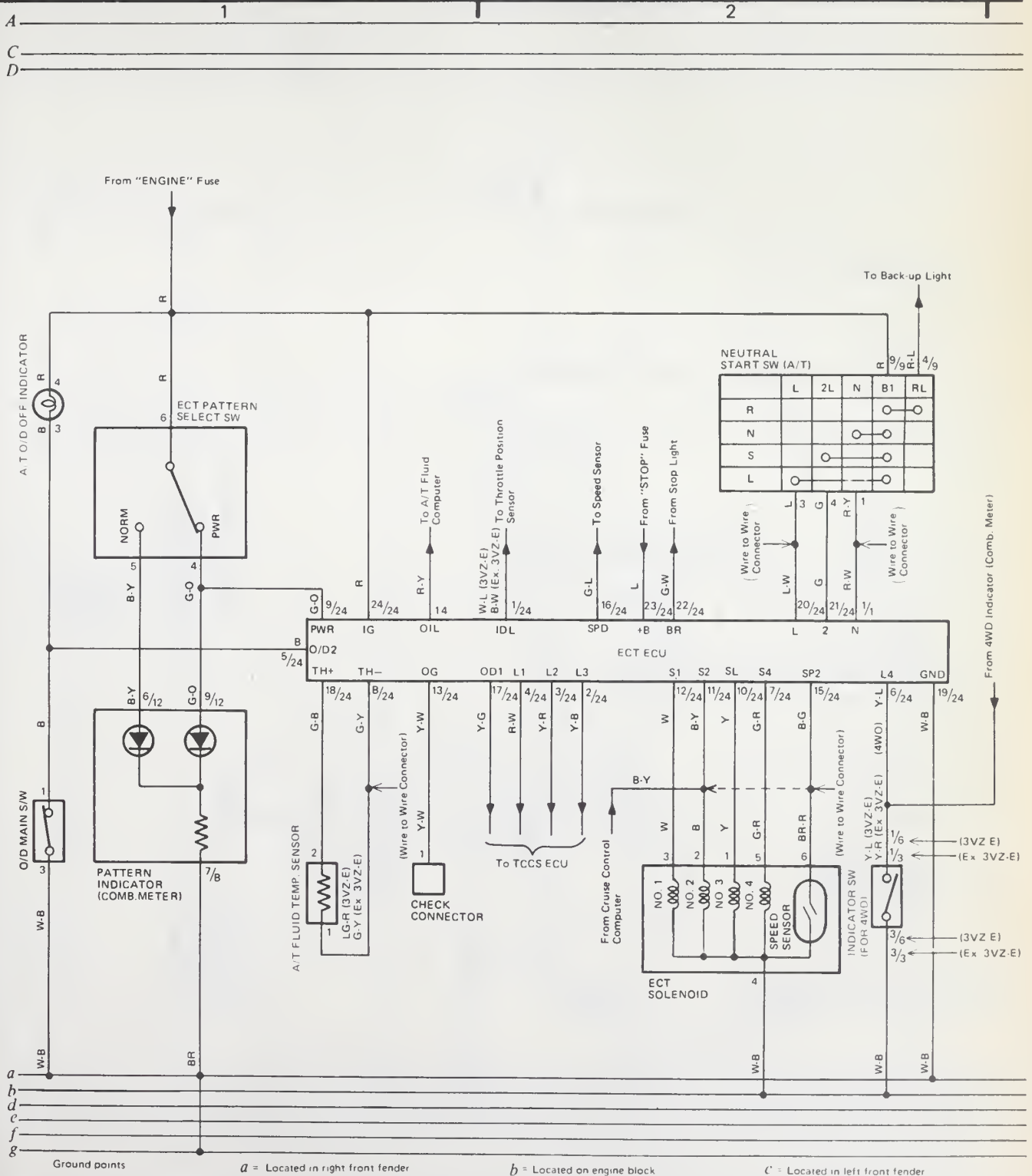
Front Wiper and Washer





ECT

ECT (Electronic Control Transmission)

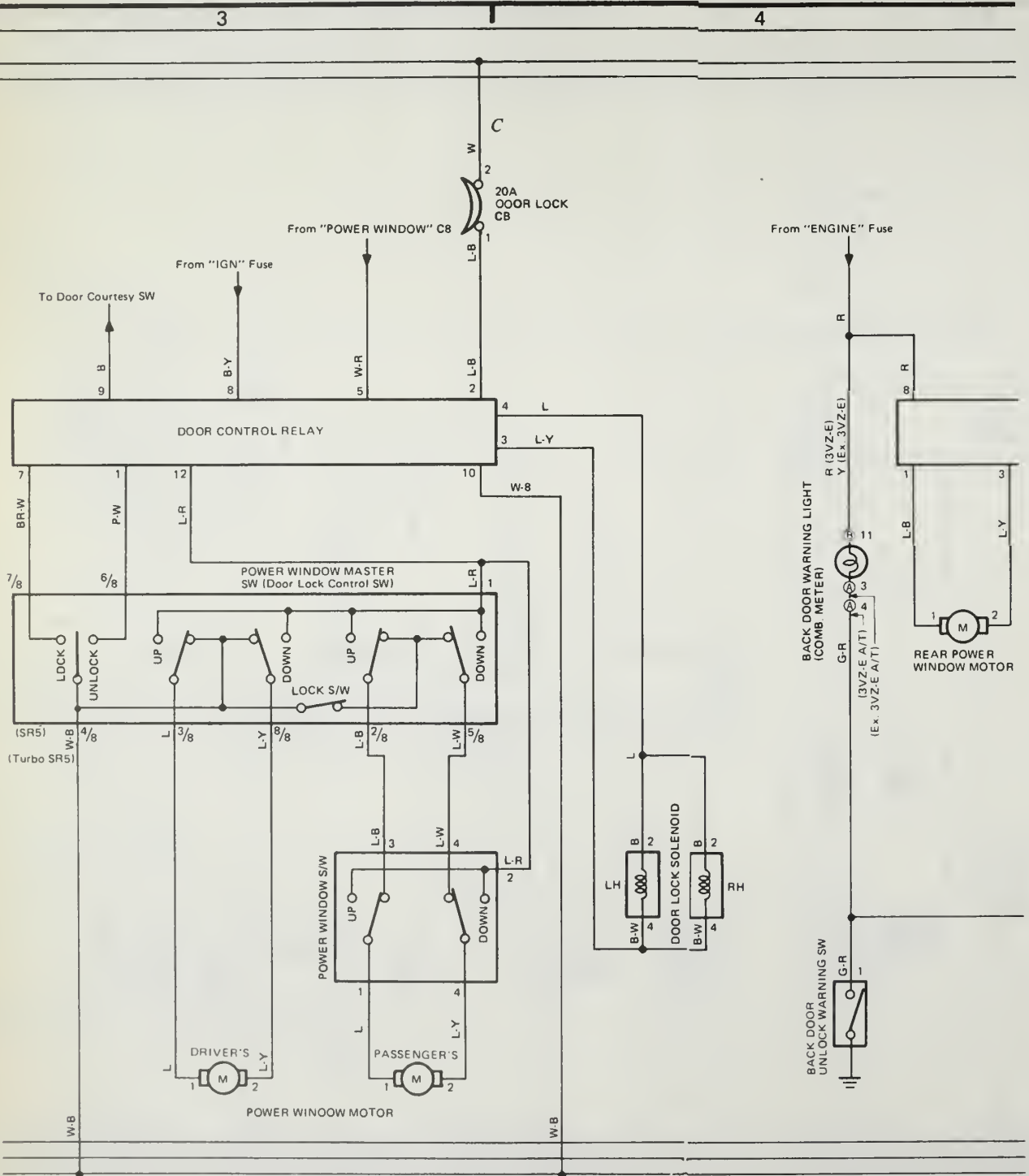


Wiring diagram — 1989 4Runner

6 CHASSIS ELECTRICAL



Power Windows (Front) and Door Locks



d - Located on rear side panel LH

f - Located on left of back panel

Wiring diagram - 1989 4Runner



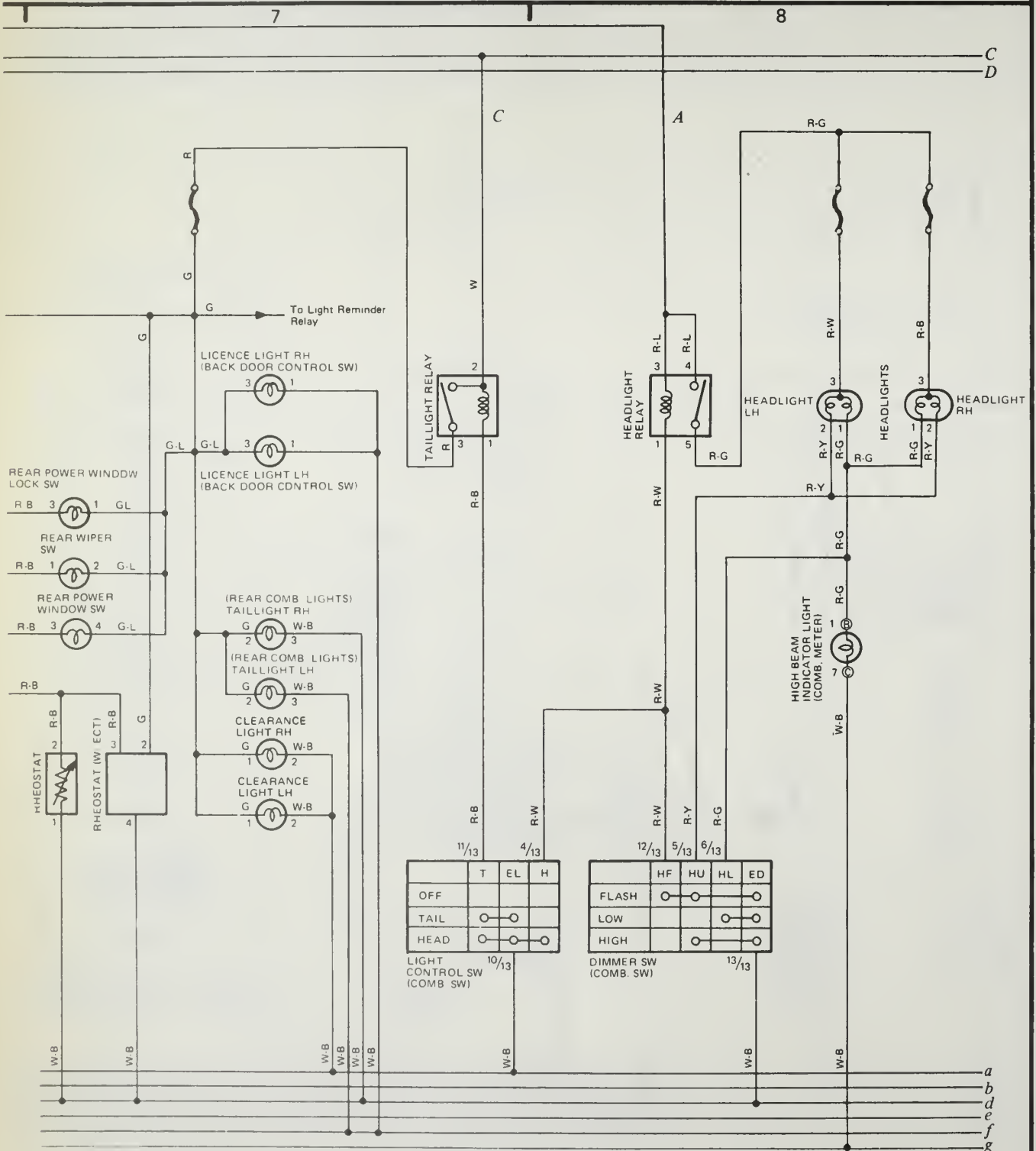
6 CHASSIS ELECTRICAL



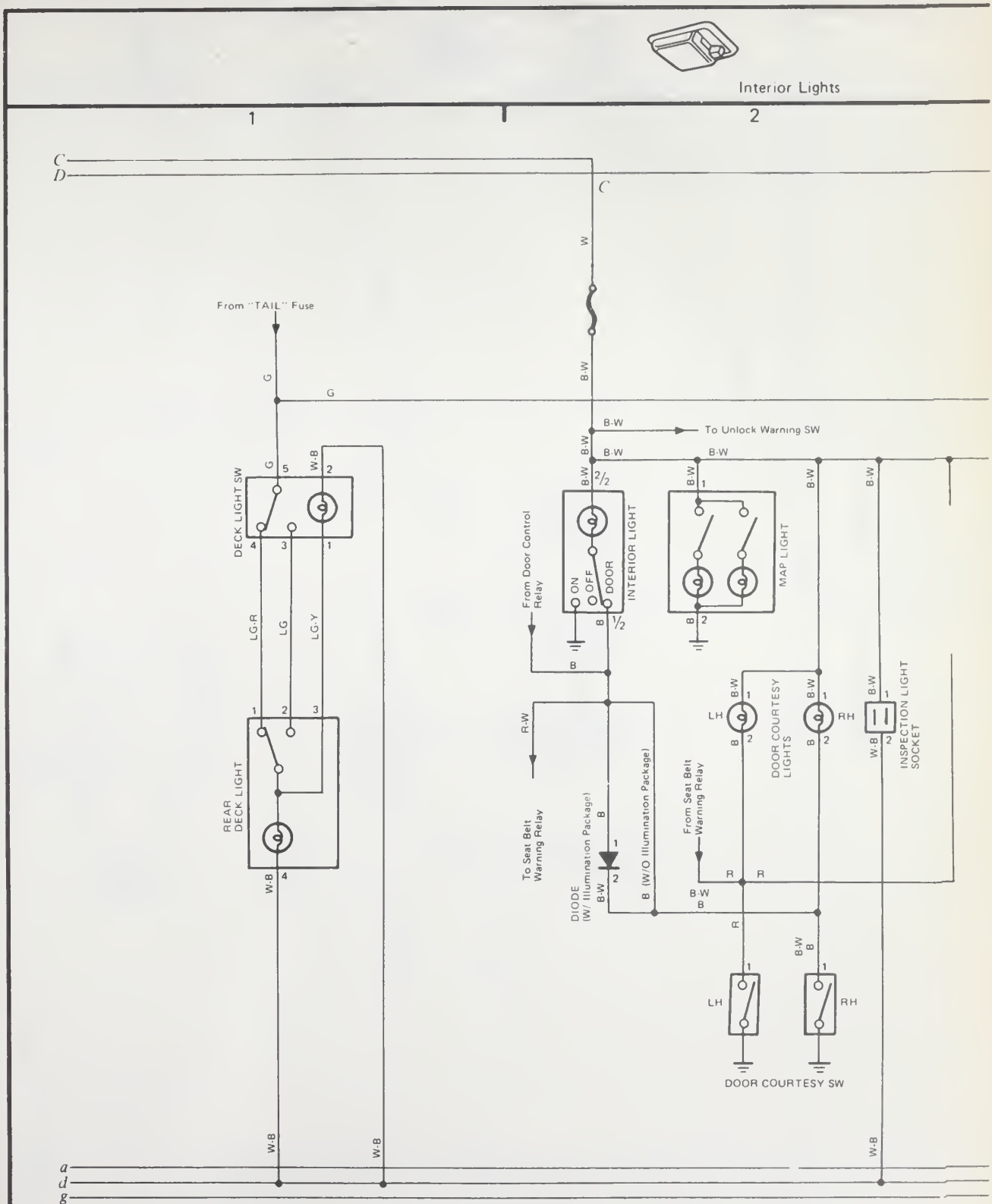
Taillights and Illumination



Headlights



Wiring diagram - 1989 4Runner



Ground points

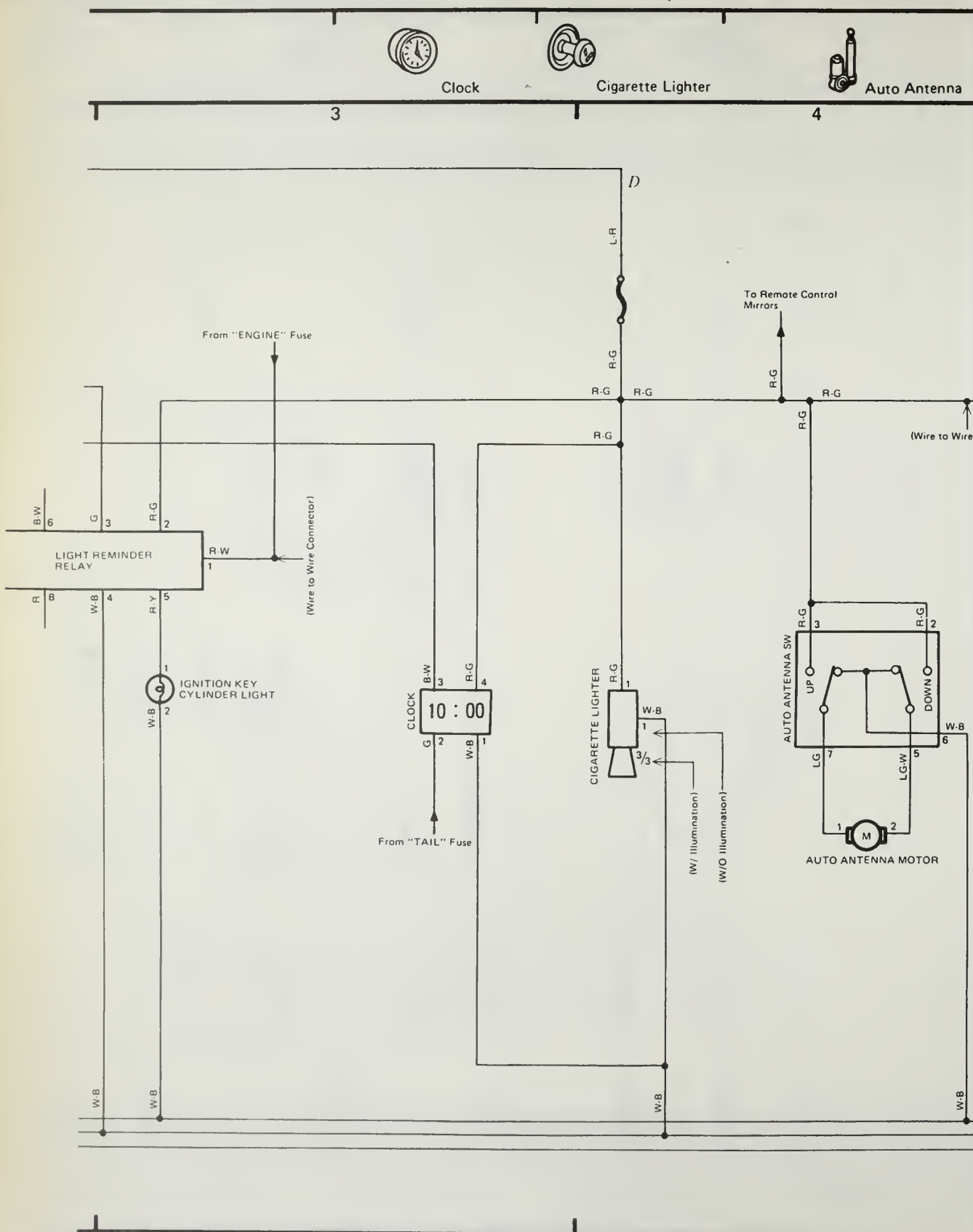
a = Located in right front fender

d = Located on rear side panel LH

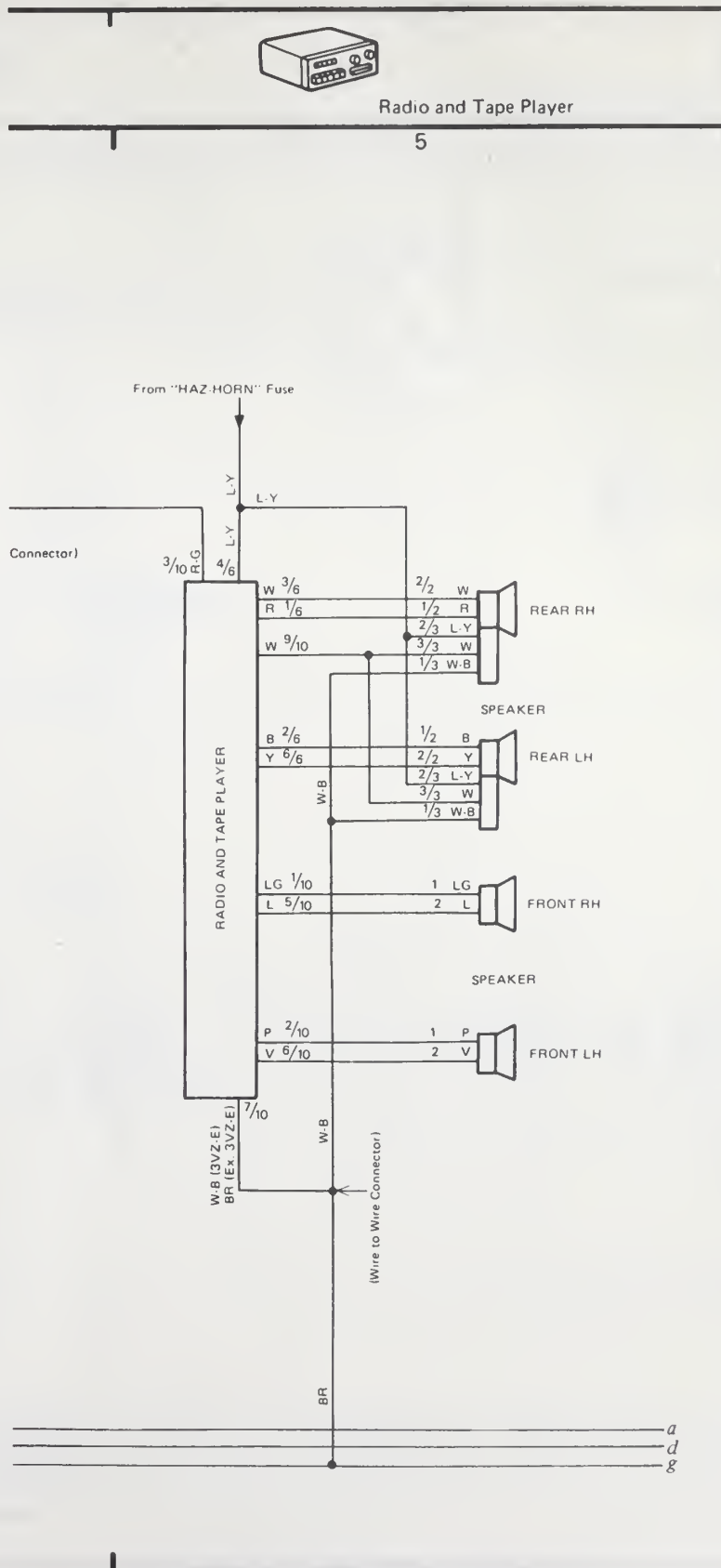
g = Located in left side of instrument panel

Wiring diagram — 1989 4Runner

6 CHASSIS ELECTRICAL

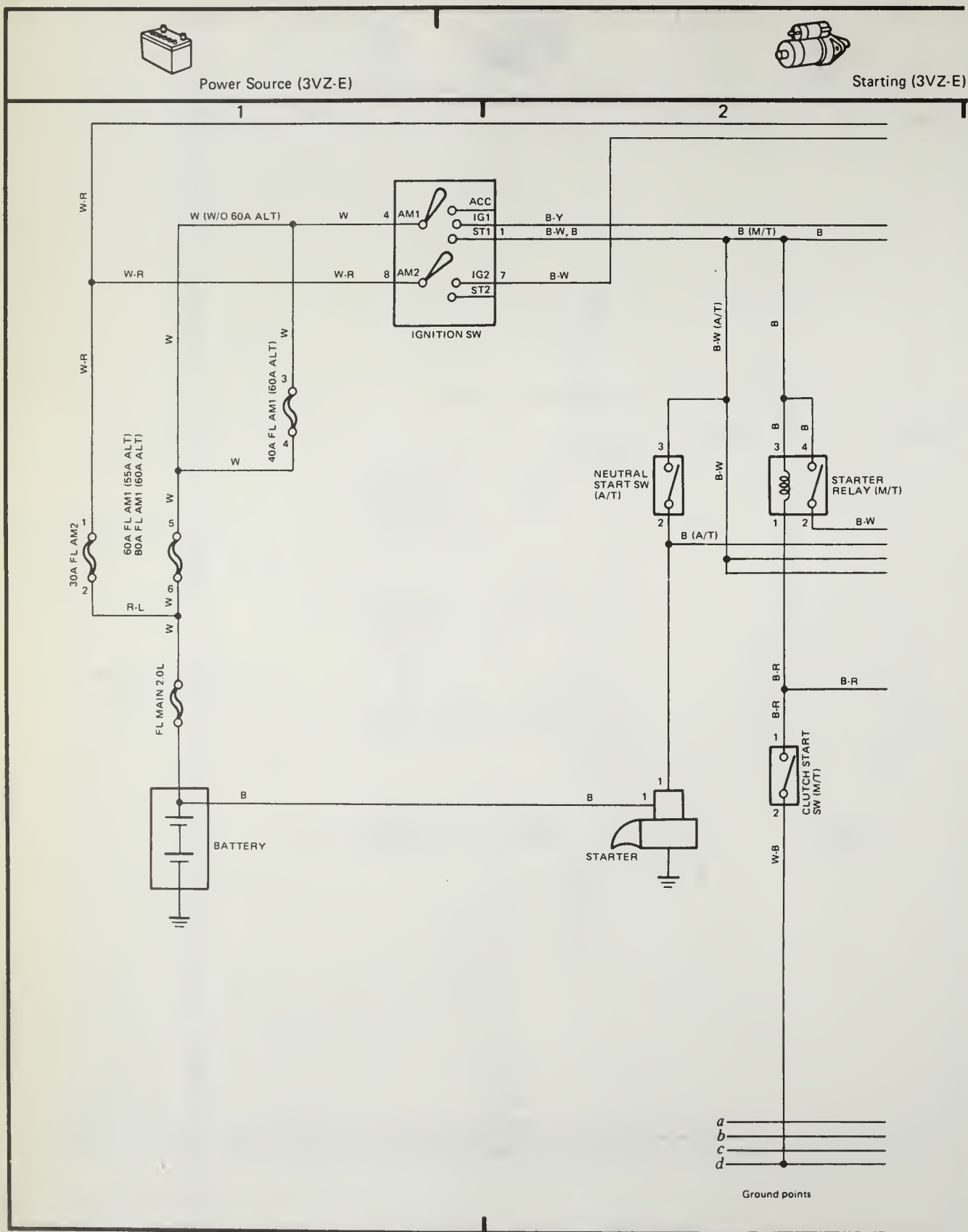


Wiring diagram — 1989 4Runner

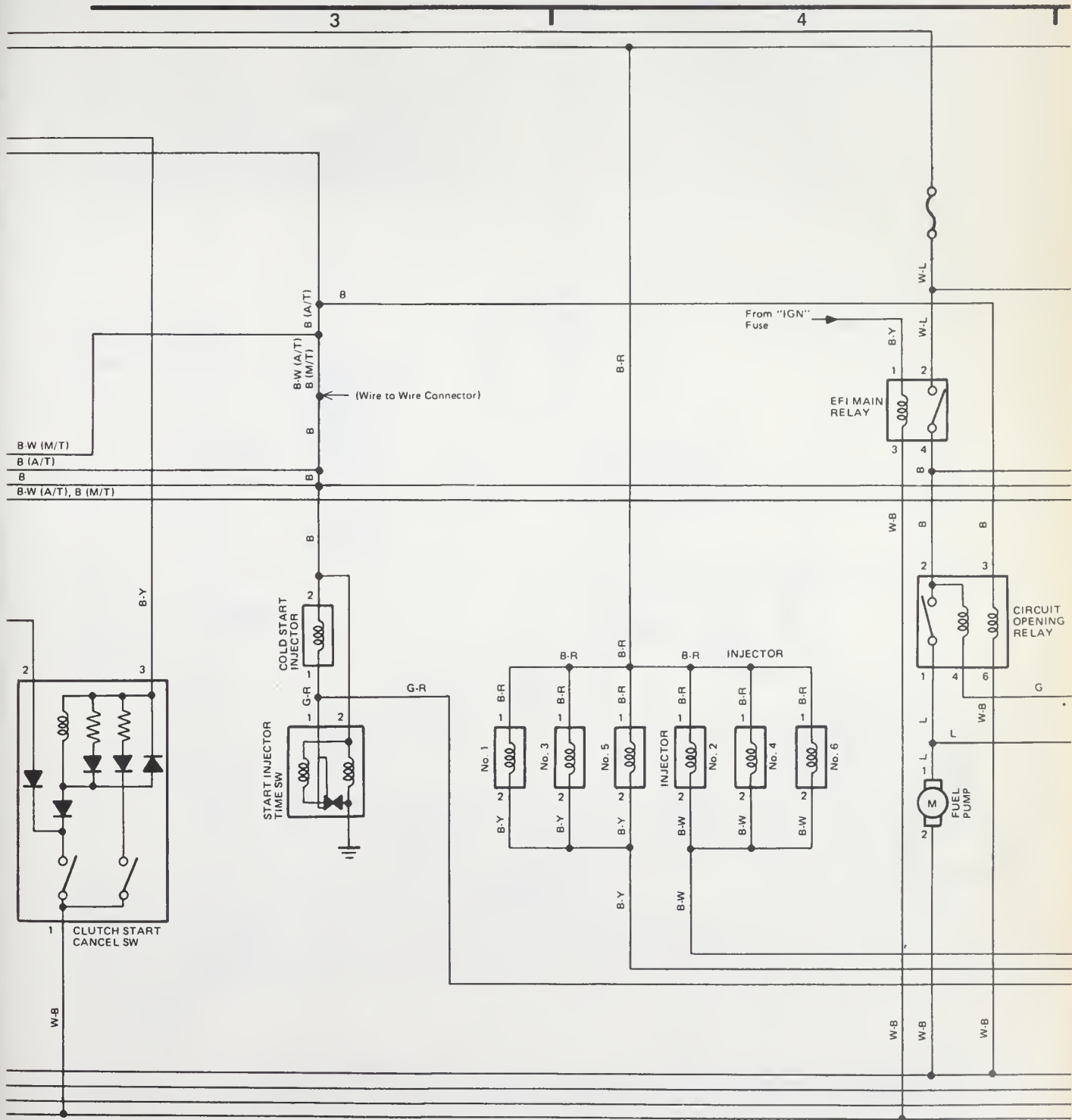


Wiring diagram -- 1989 4Runner

6 CHASSIS ELECTRICAL



Wiring diagram — 1989 4Runner



a = Located in right front fender

b = Located on engine block

c = Located in left front fender

Wiring diagram — 1989 4Runner

6 CHASSIS ELECTRICAL

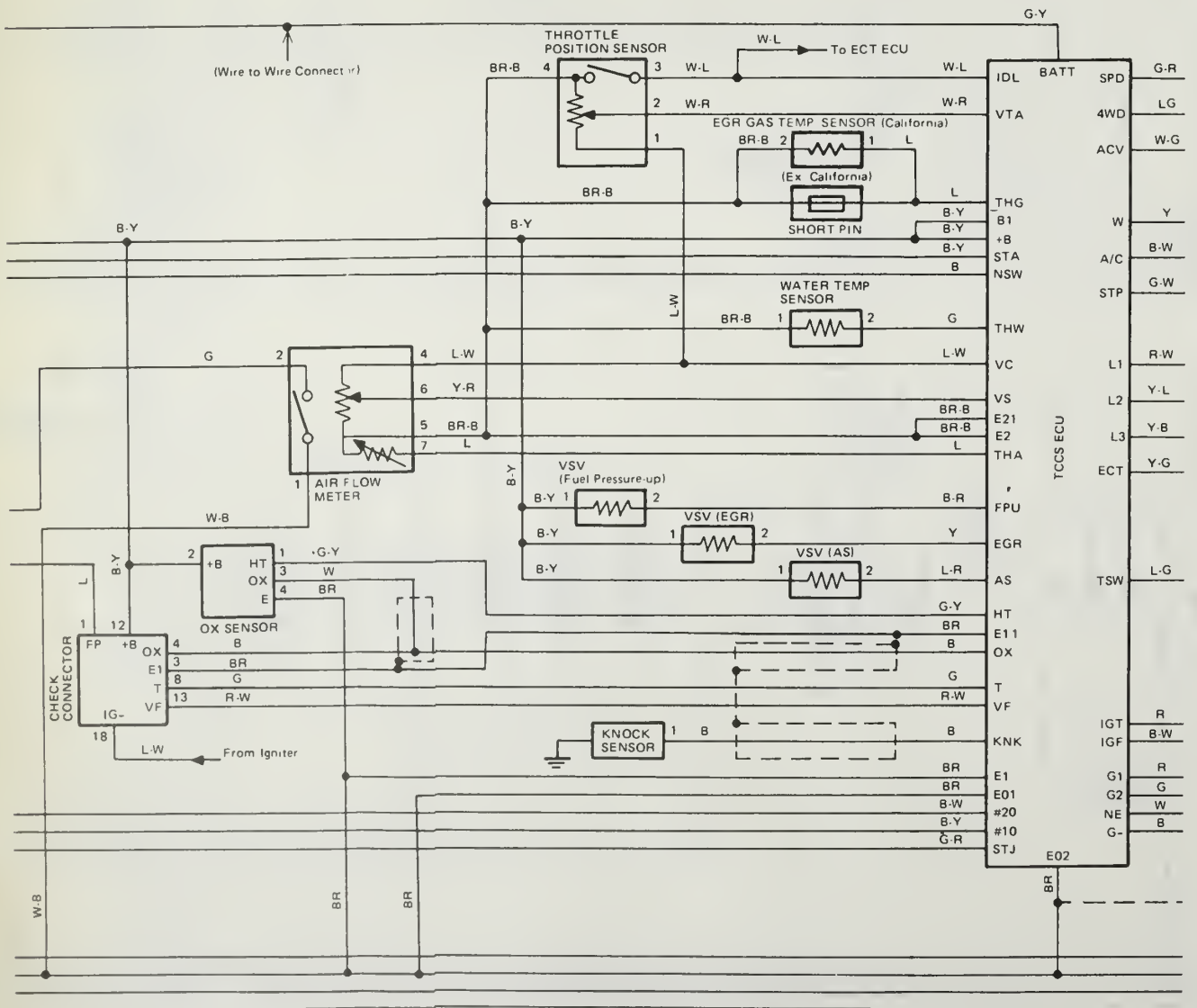
TCCS

TCCS (3VZ-E)

5

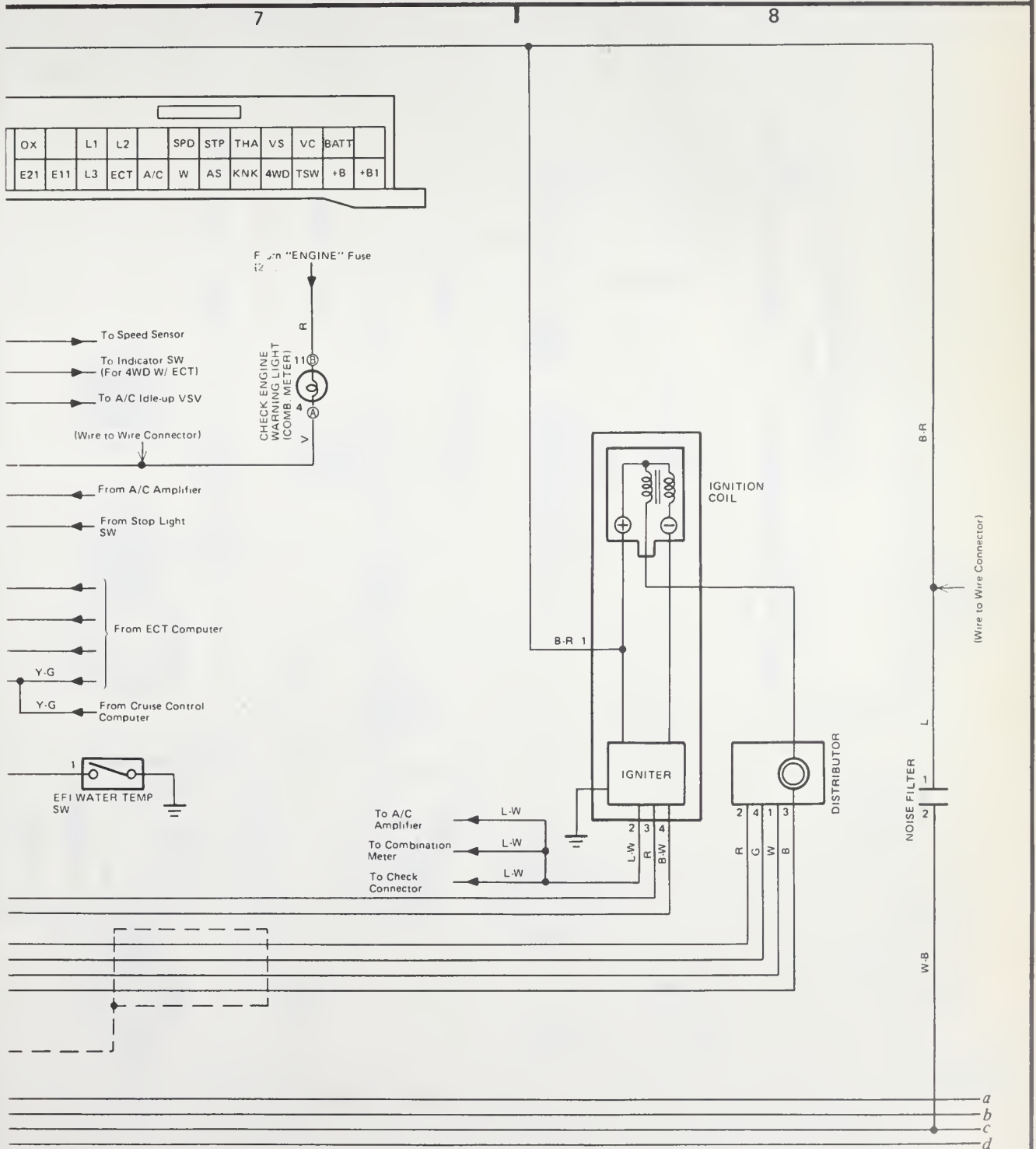
6

E01	#10	STA	STJ	NSW		FPU	G-	G1	G2	NE	HT	IGF	THW
E02	#20	1GT	E1			THG	ACV	VF	T	VTA	IDL	EGR	E2



d = Located on rear side panel LH

Wiring diagram — 1989 4Runner



Wiring diagram – 1989 4Runner

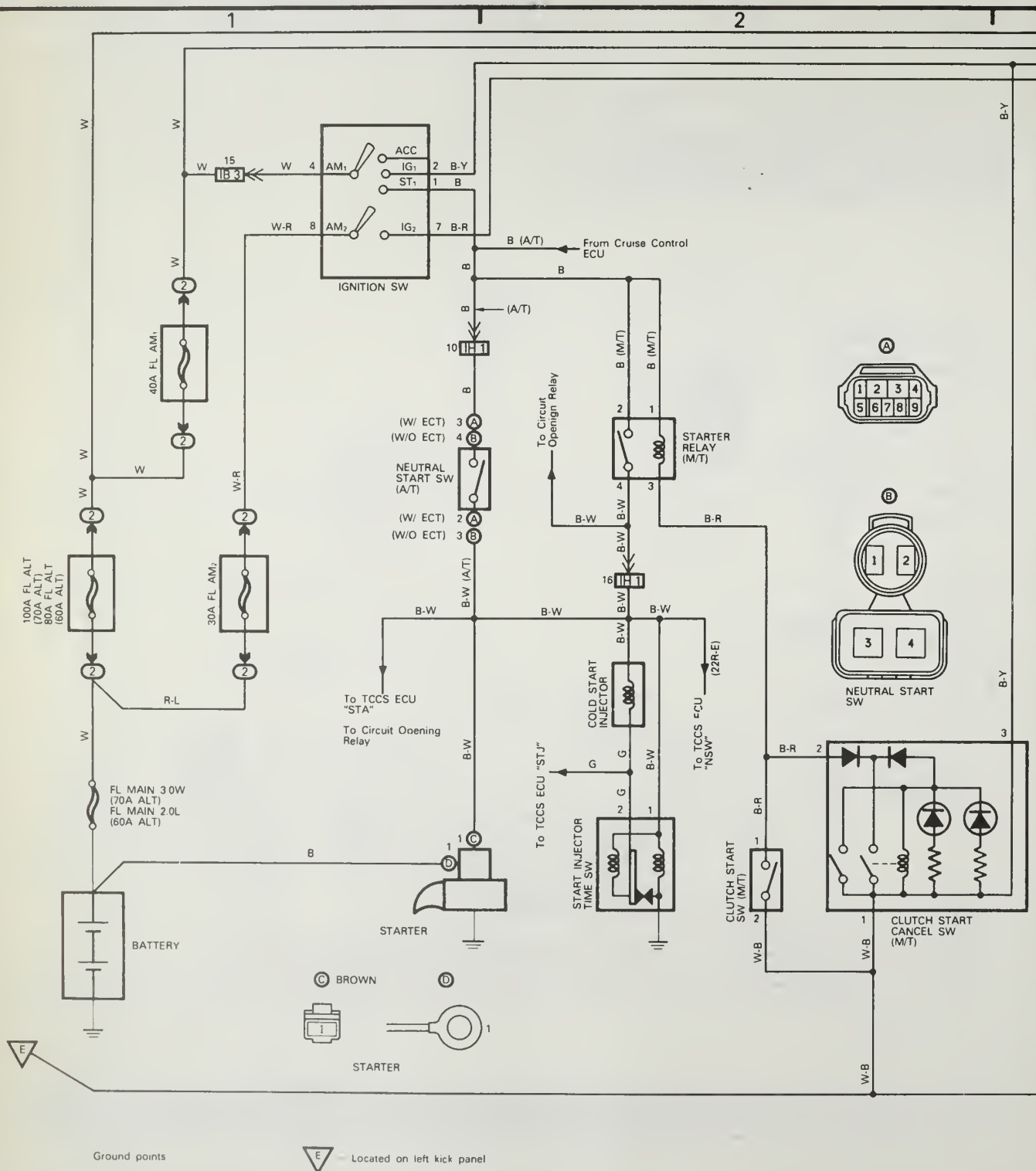
6 CHASSIS ELECTRICAL



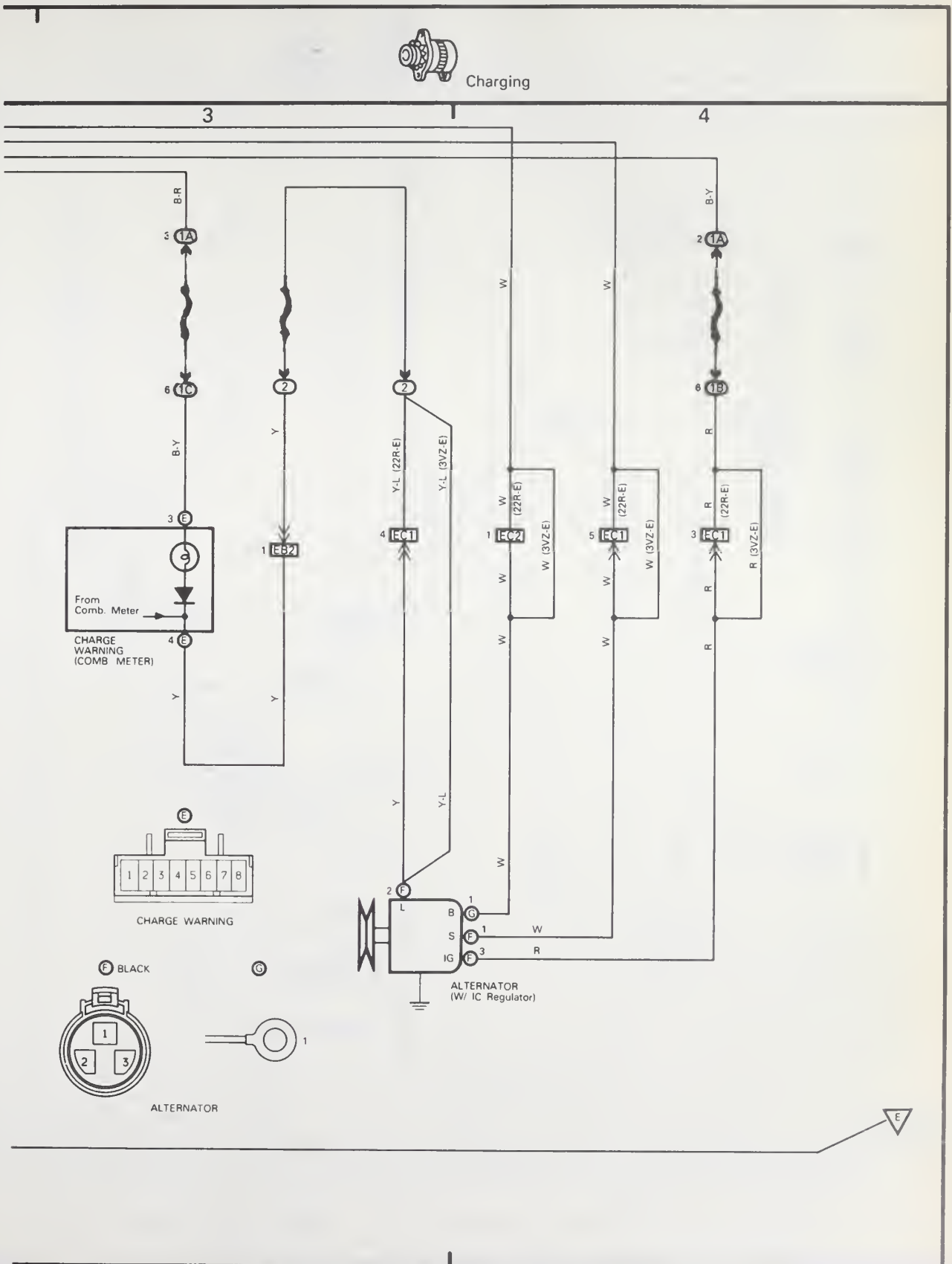
Power Source



Starting

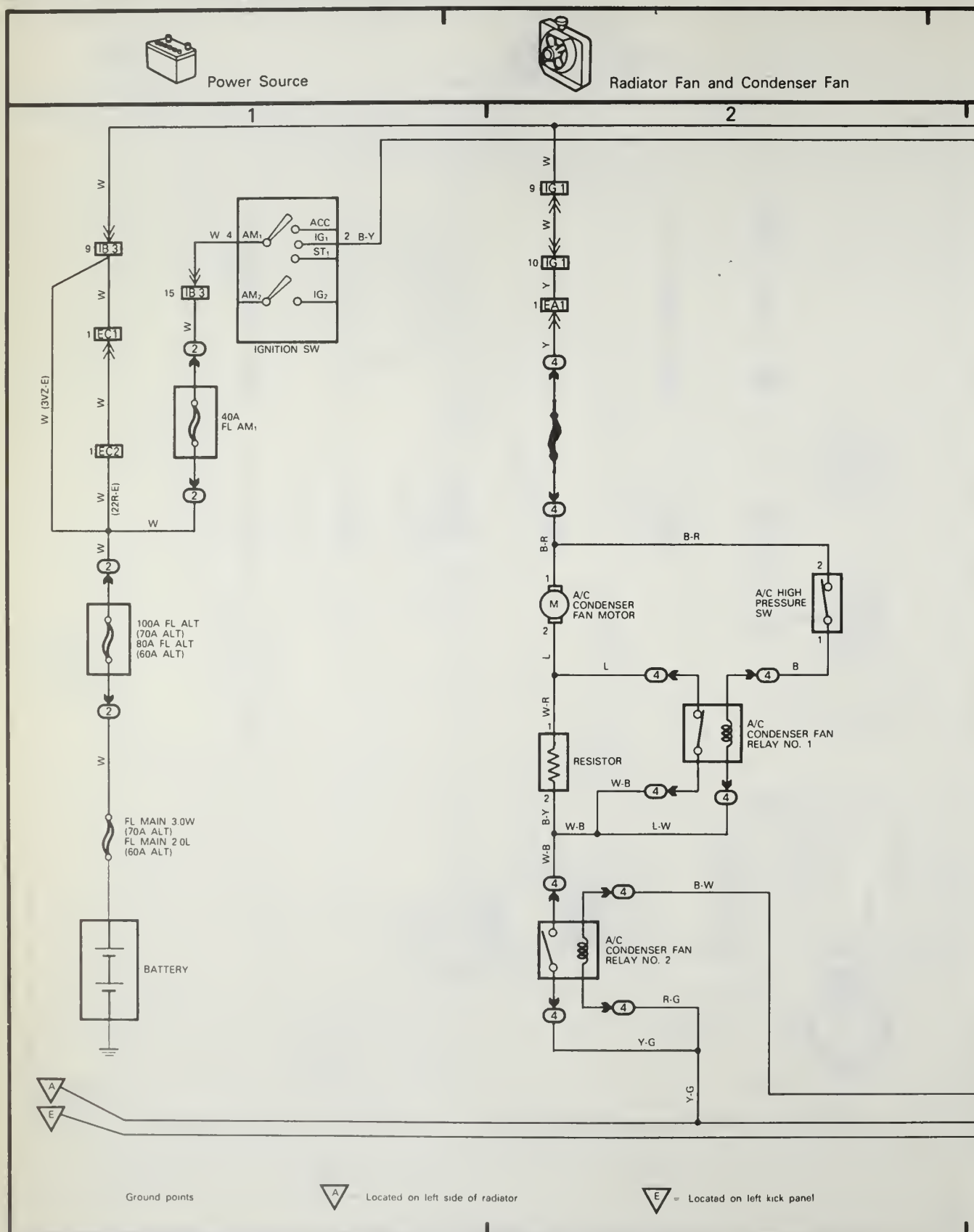


Wiring diagram — 1990 4Runner



Wiring diagram — 1990 4Runner

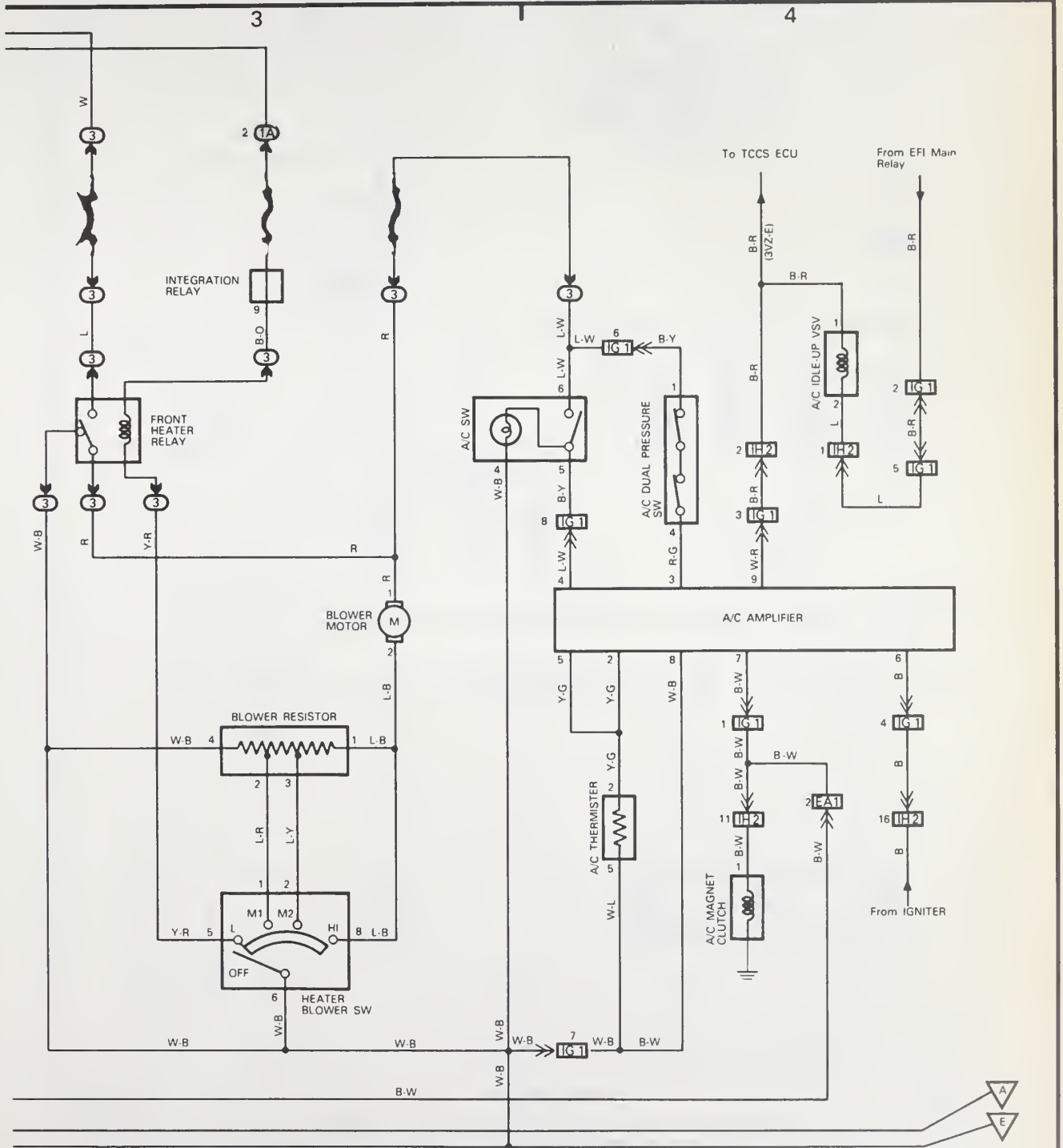
6 CHASSIS ELECTRICAL



Wiring diagram — 1990 4Runner

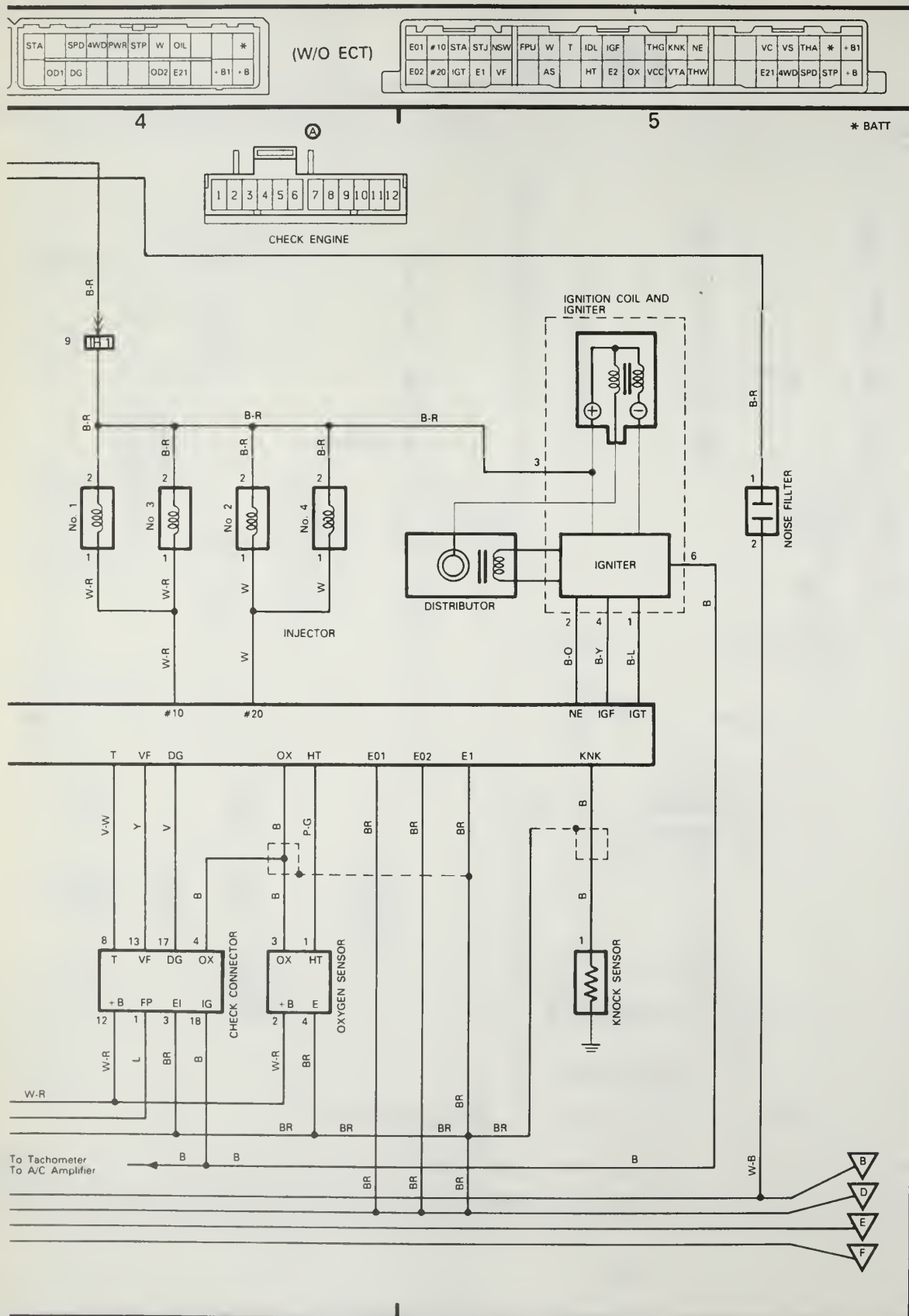


Air Conditioner, Cooler and Heater



Wiring diagram – 1990 4Runner

6 CHASSIS ELECTRICAL

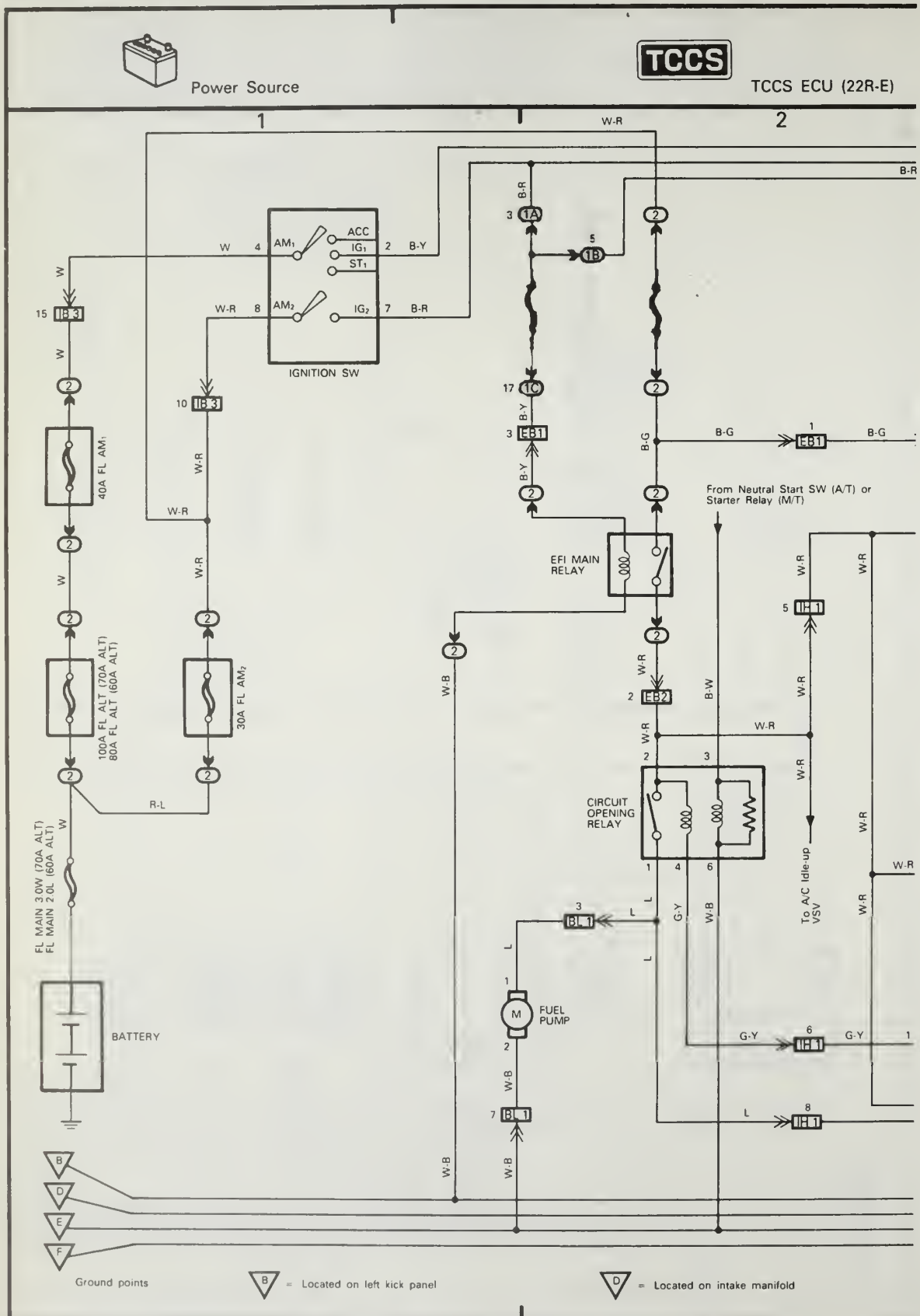


Wiring diagram — 1990 4Runner

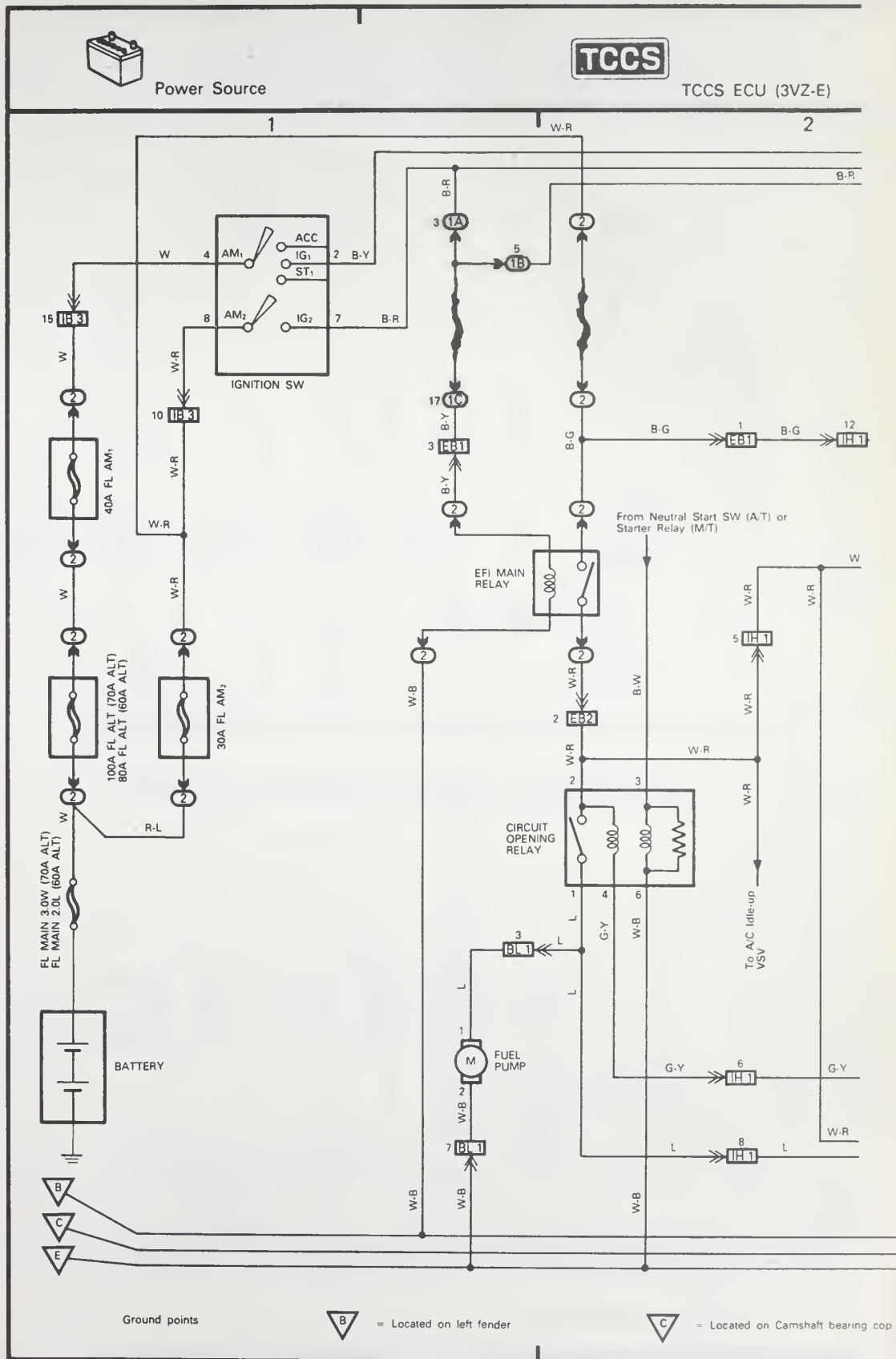


6-167

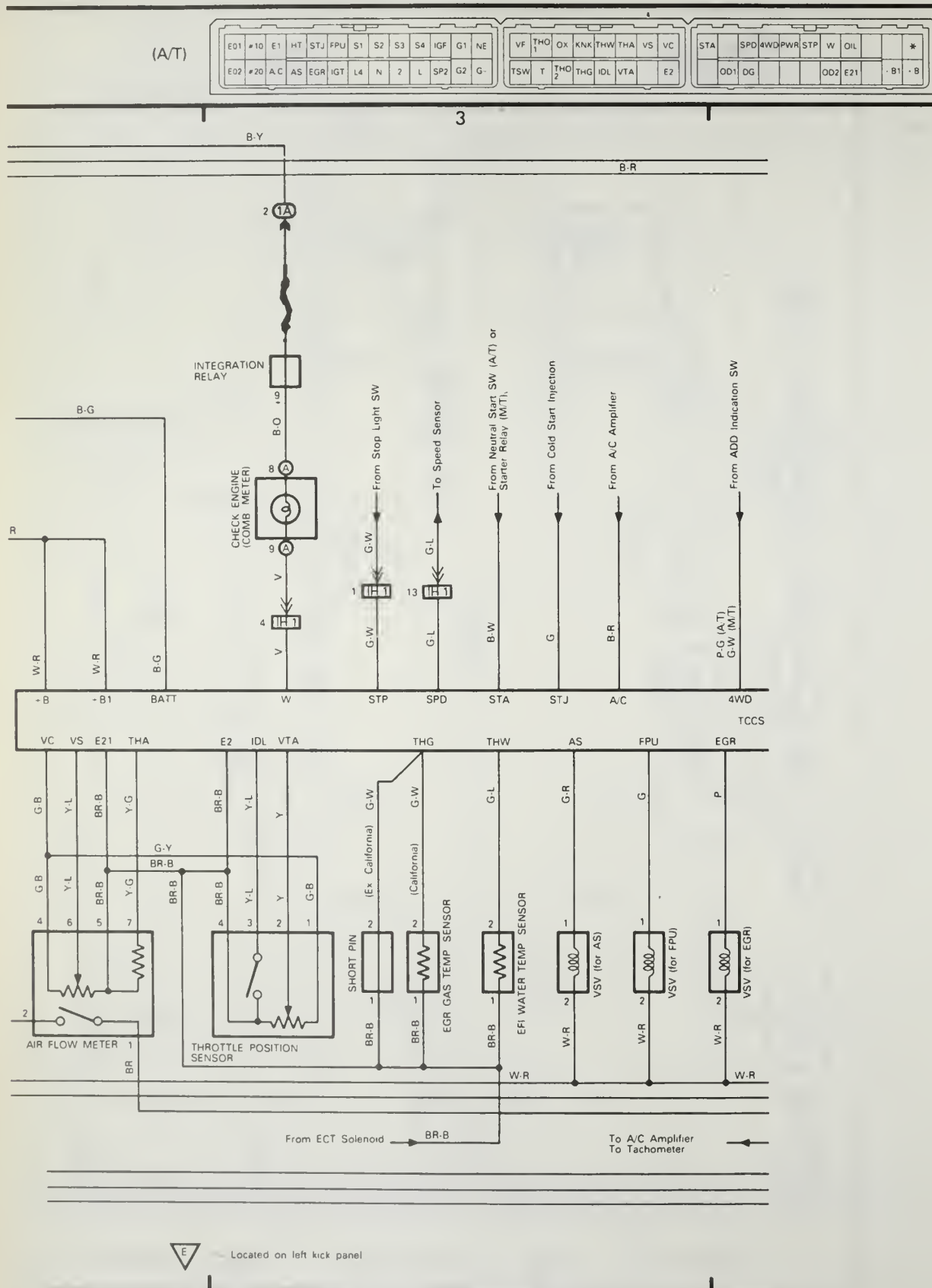
6 CHASSIS ELECTRICAL



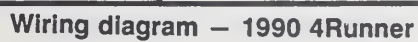
Wiring diagram – 1990 4Runner



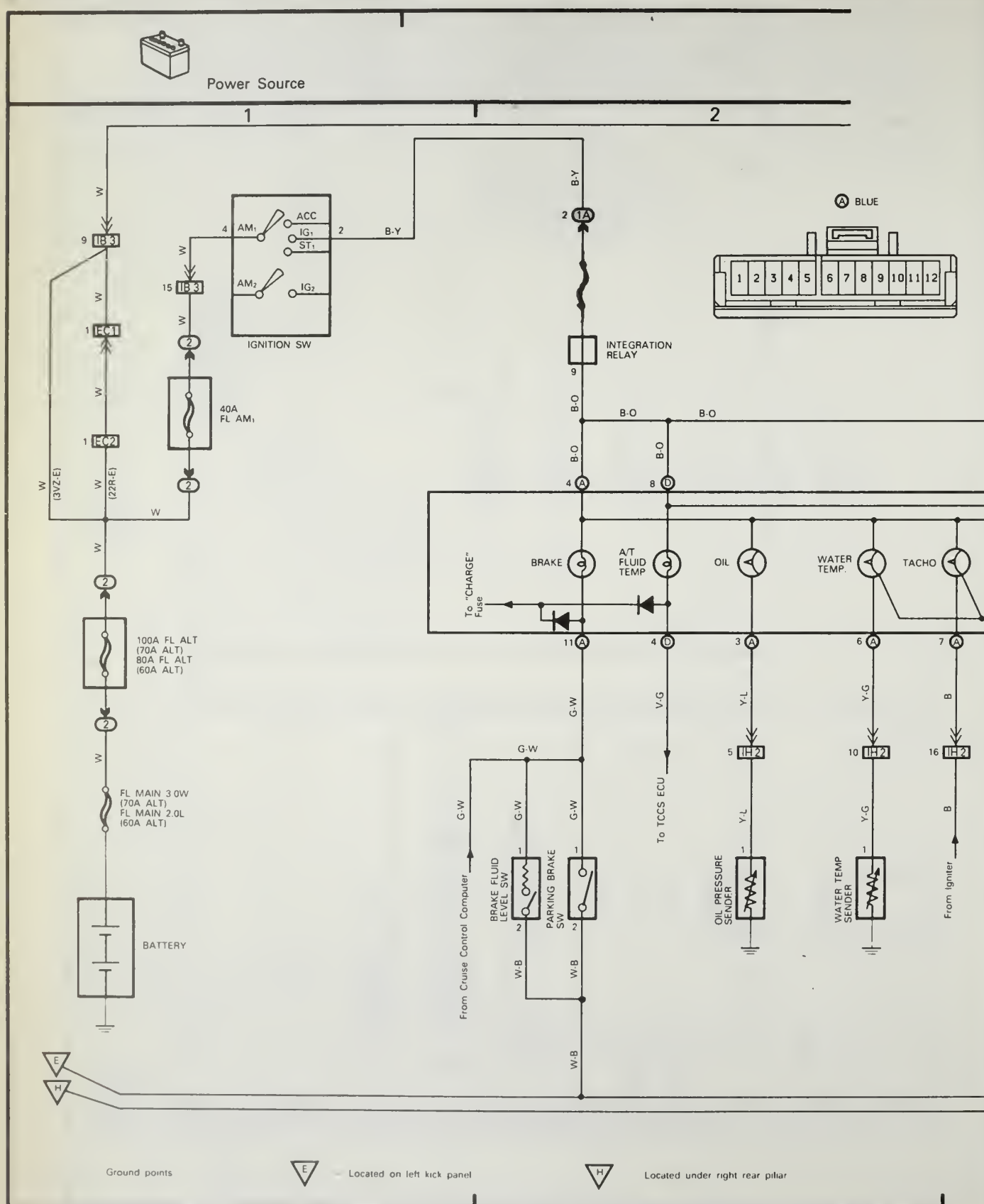
6 CHASSIS ELECTRICAL



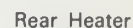
Wiring diagram – 1990 4Runner



6 CHASSIS ELECTRICAL



Wiring diagram — 1990 4Runner



Wiring diagram – 1990 4Runner

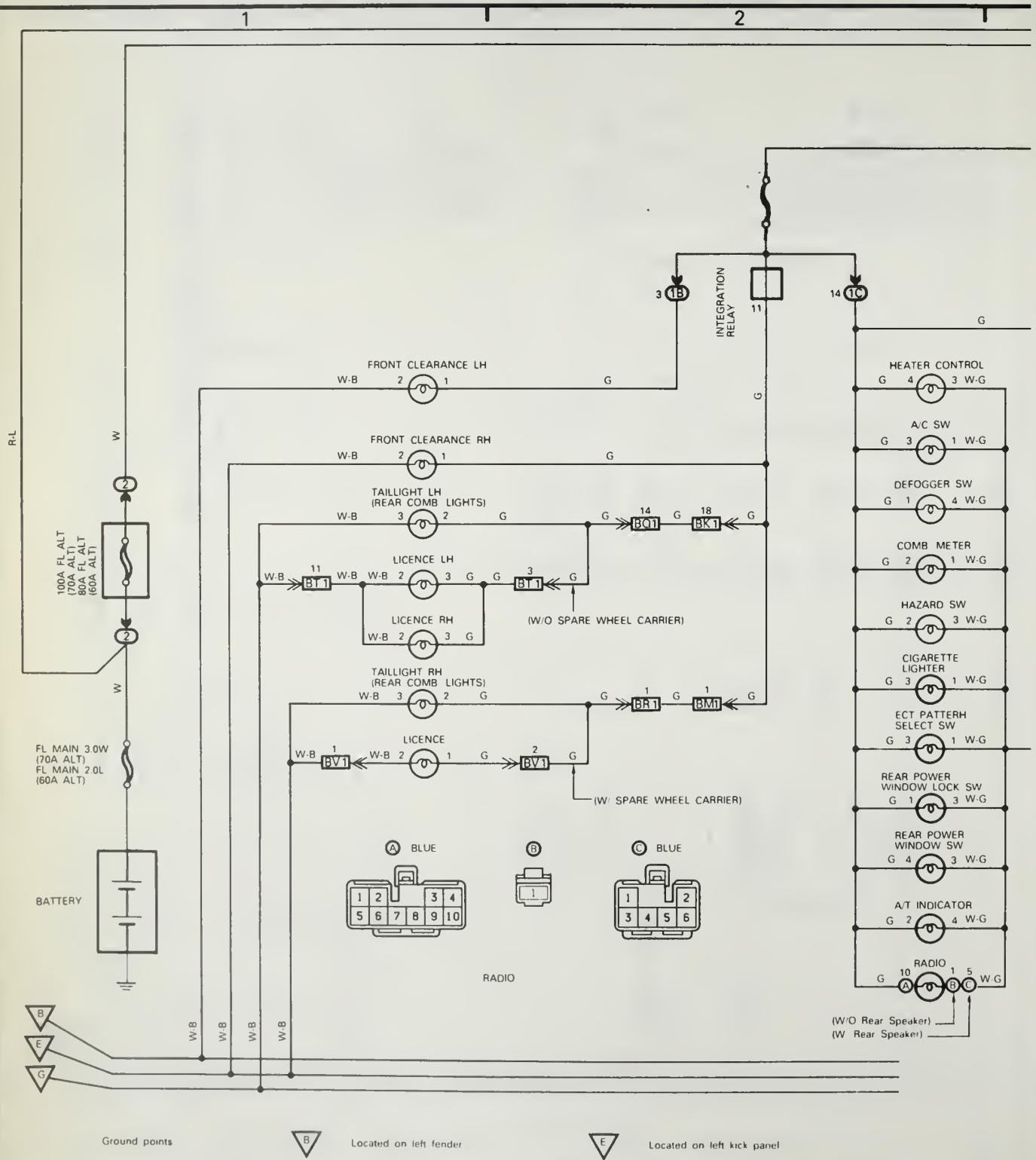
6 CHASSIS ELECTRICAL



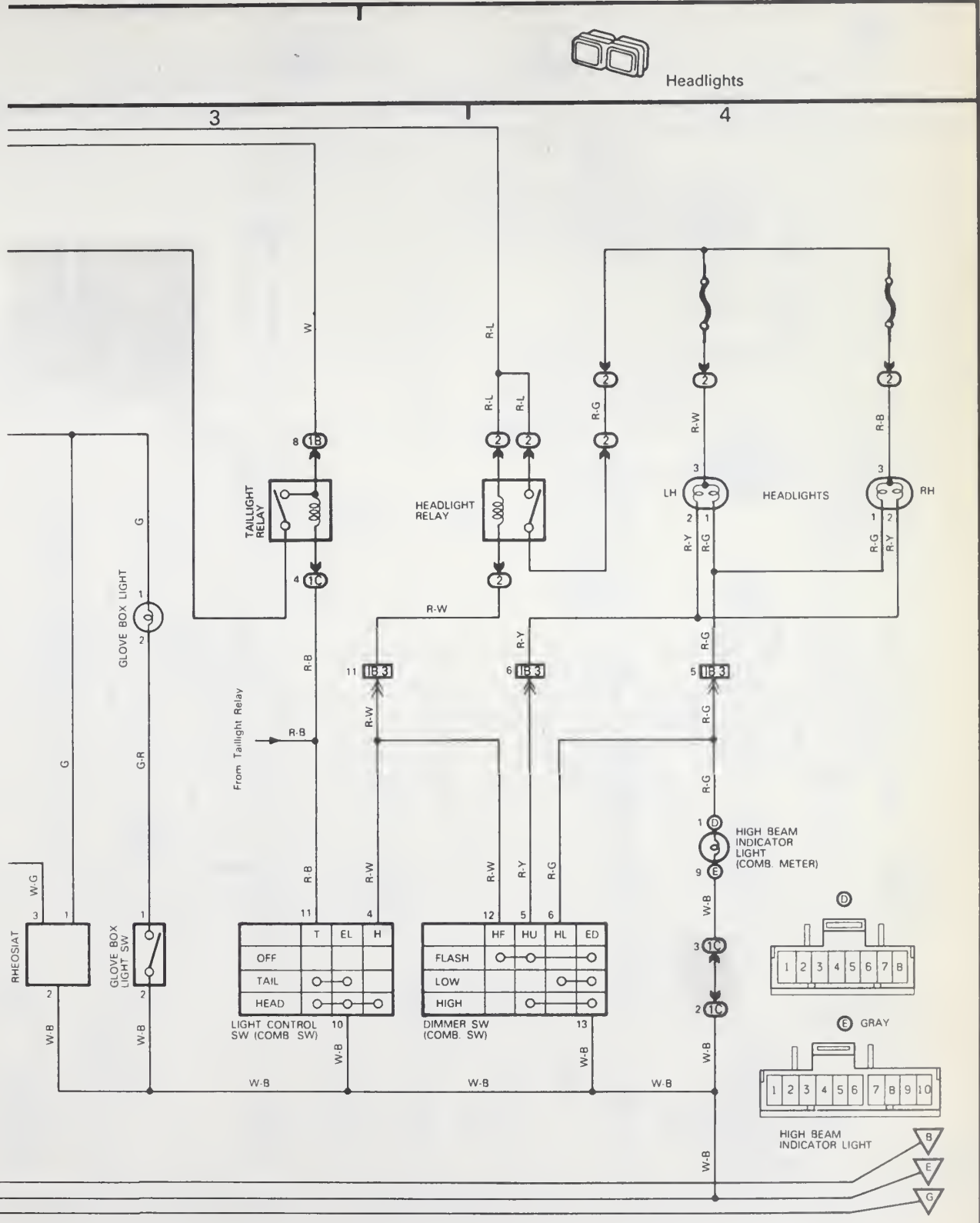
Power Source



Taillights and Illumination



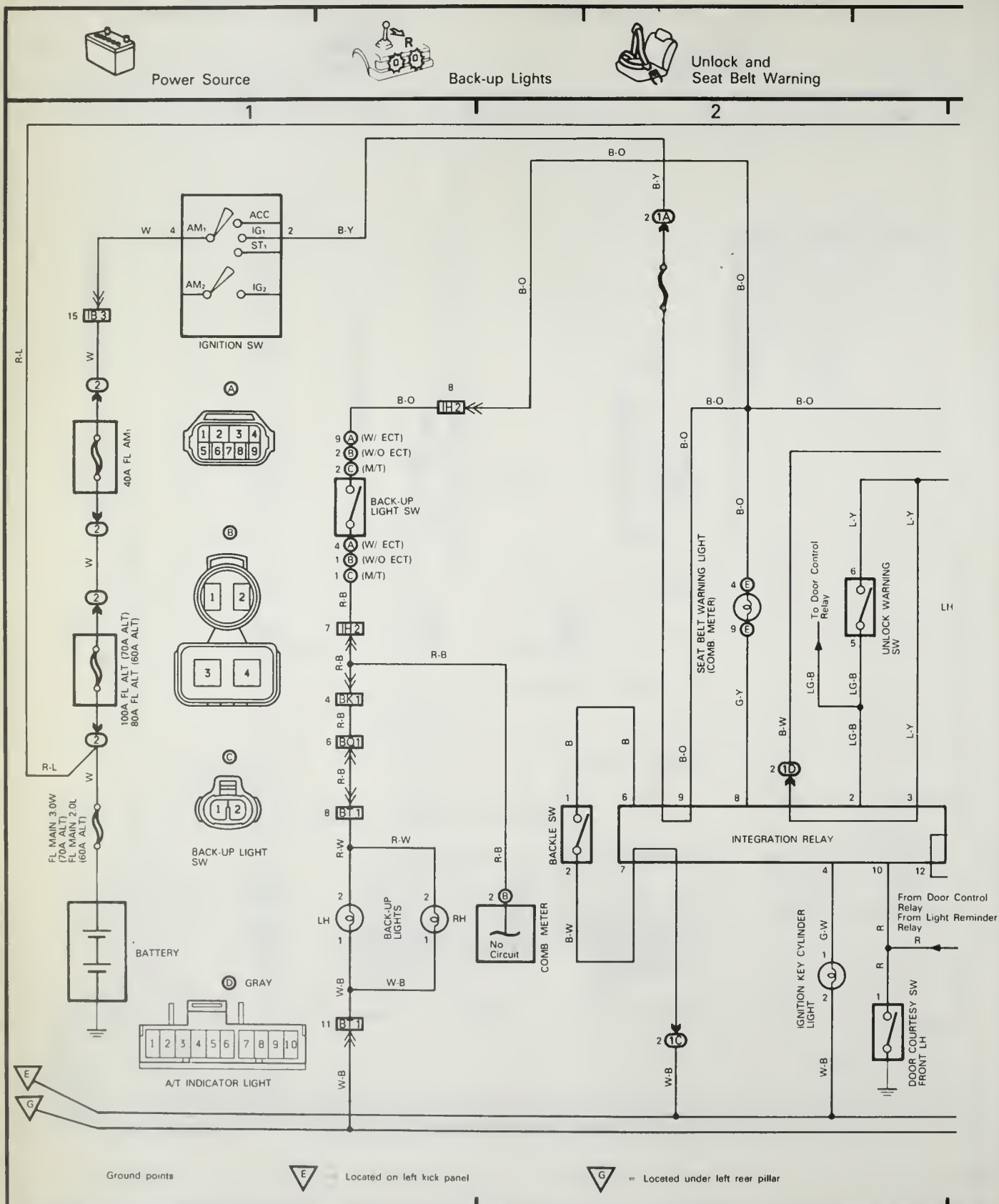
Wiring diagram — 1990 4Runner



 Located under left rear pillar

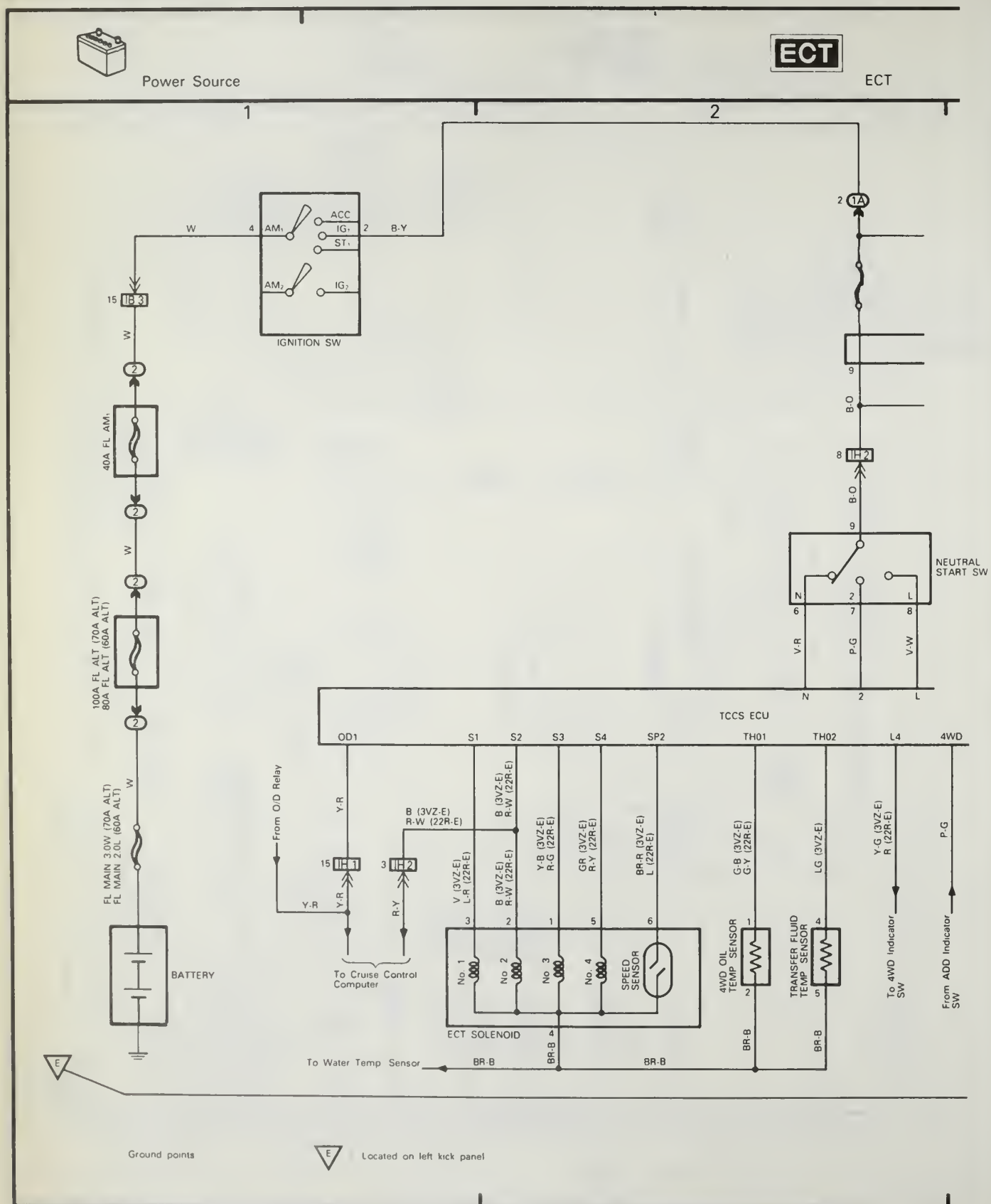
Wiring diagram — 1990 4Runner

6 CHASSIS ELECTRICAL

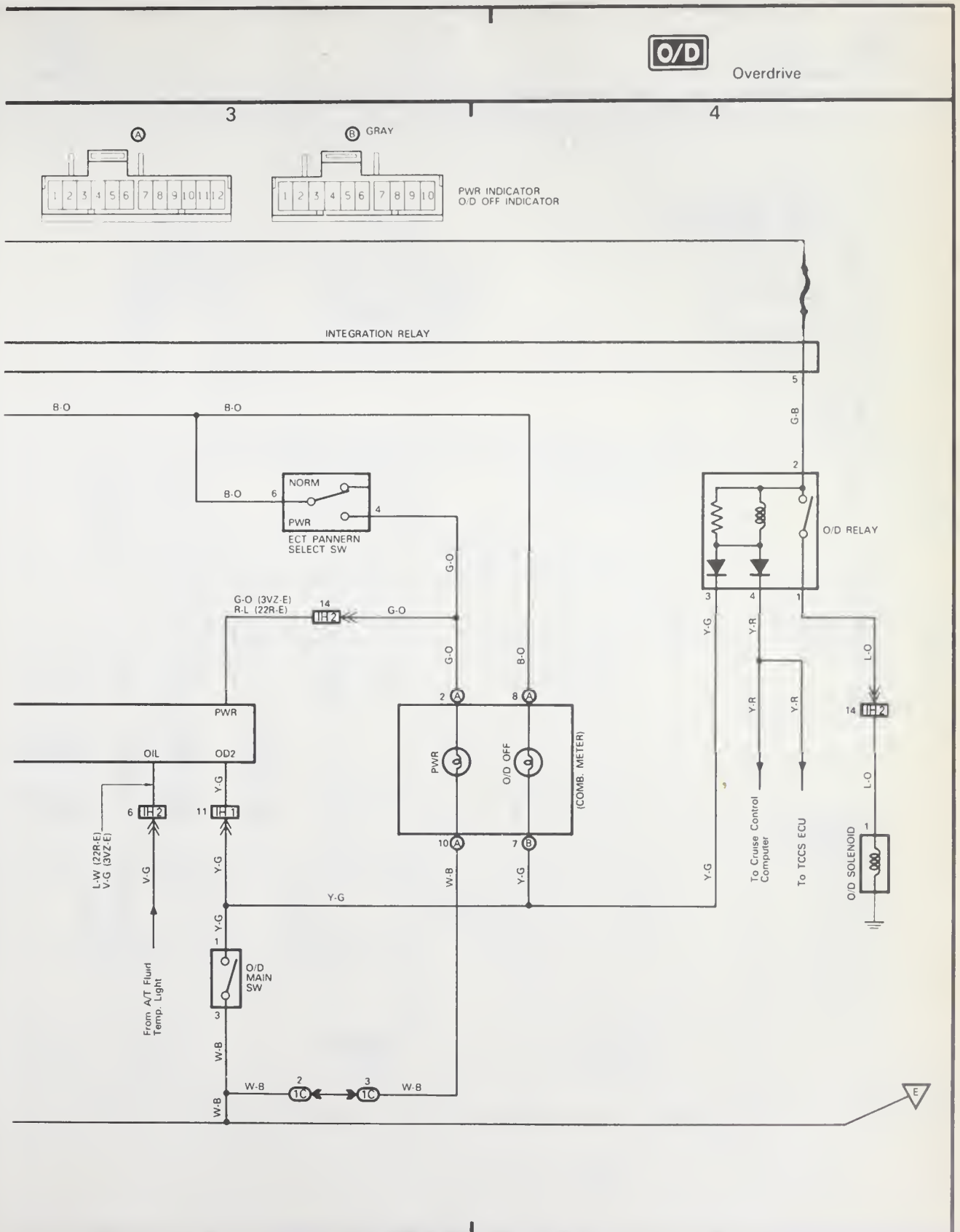


Wiring diagram — 1990 4Runner

6 CHASSIS ELECTRICAL

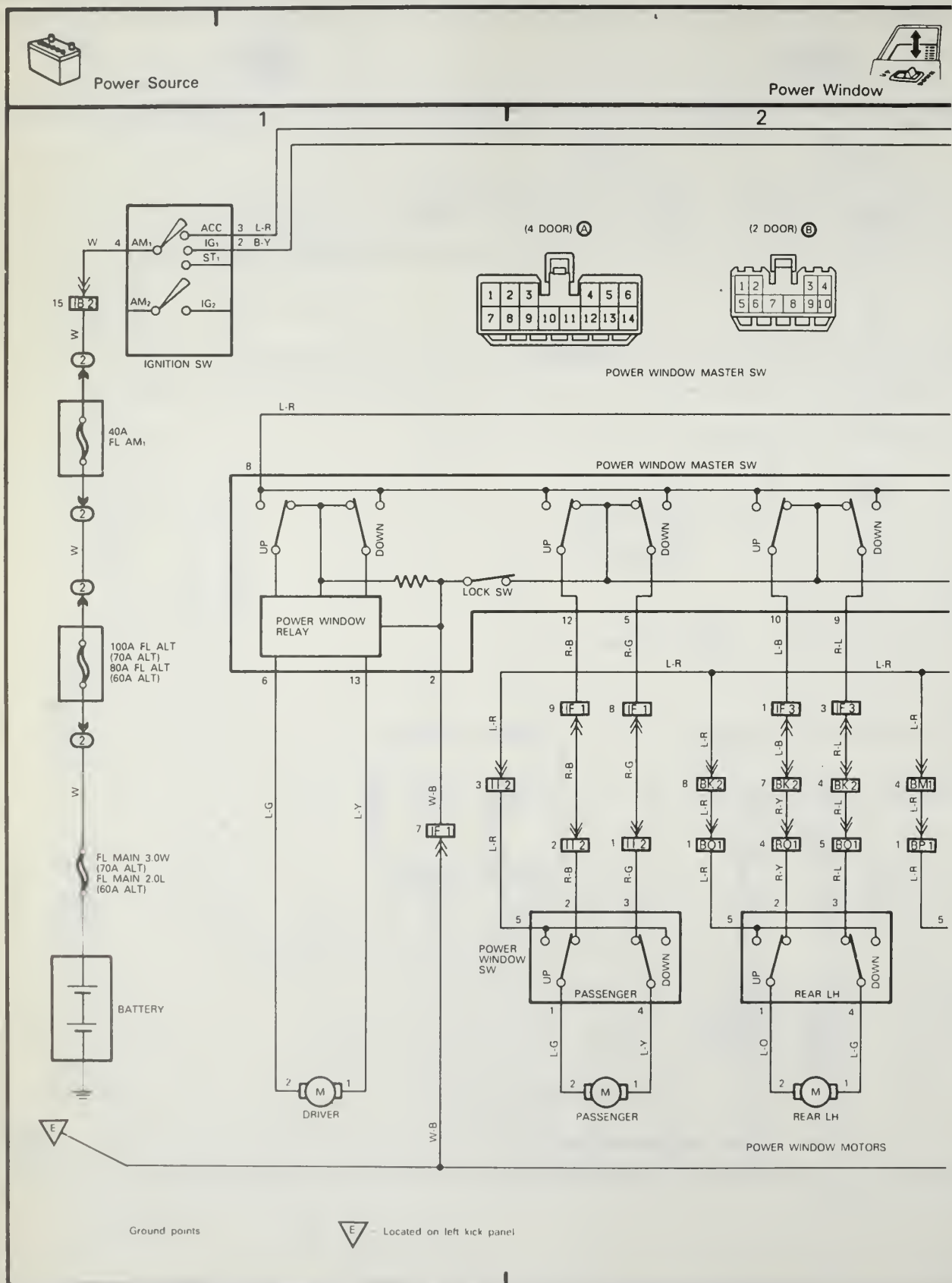


Wiring diagram – 1990 4Runner

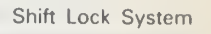


Wiring diagram – 1990 4Runner

6 CHASSIS ELECTRICAL

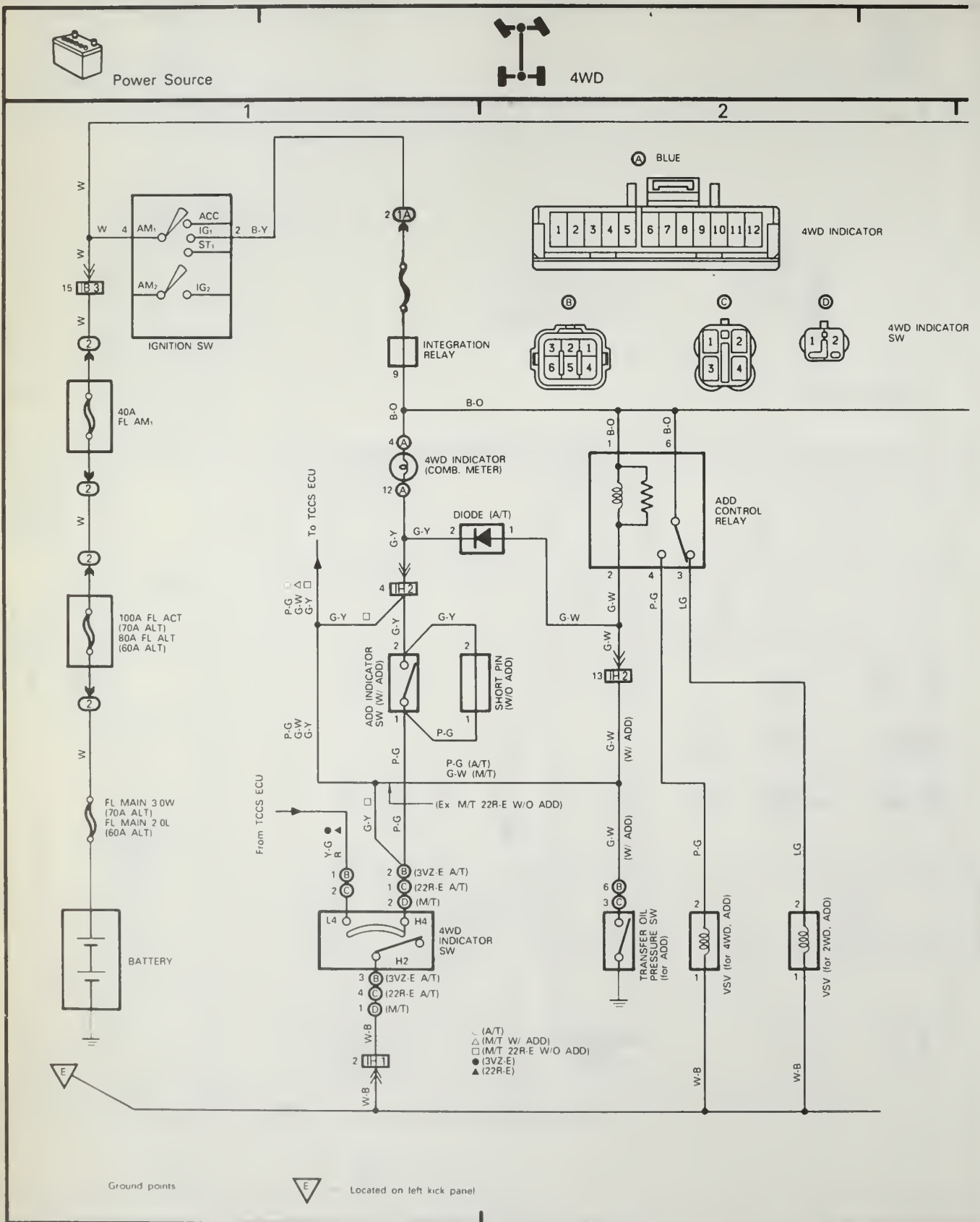


Wiring diagram — 1990 4Runner



Wiring diagram – 1990 4Runner

6 CHASSIS ELECTRICAL

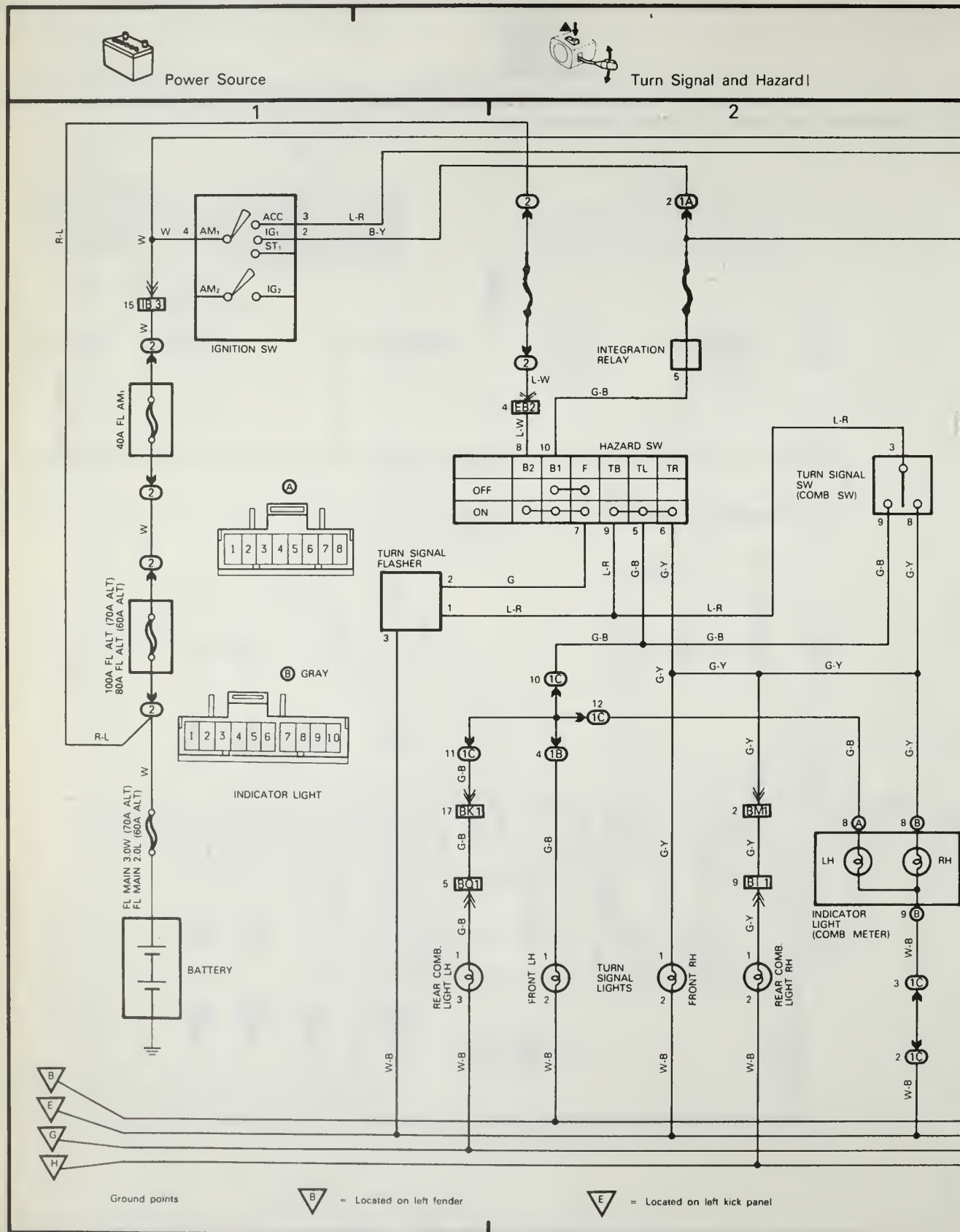


Wiring diagram — 1990 4Runner

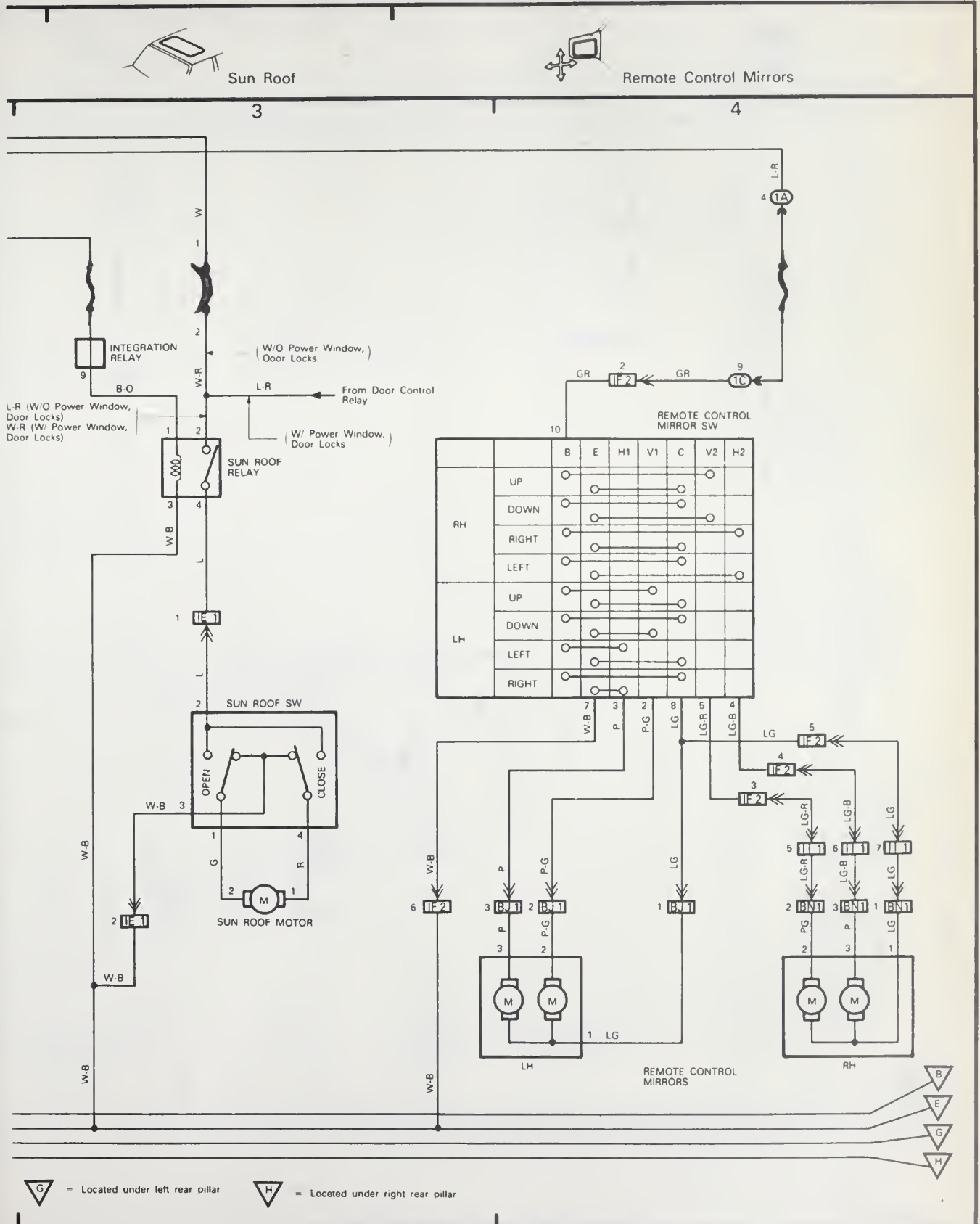


6-183

6 CHASSIS ELECTRICAL

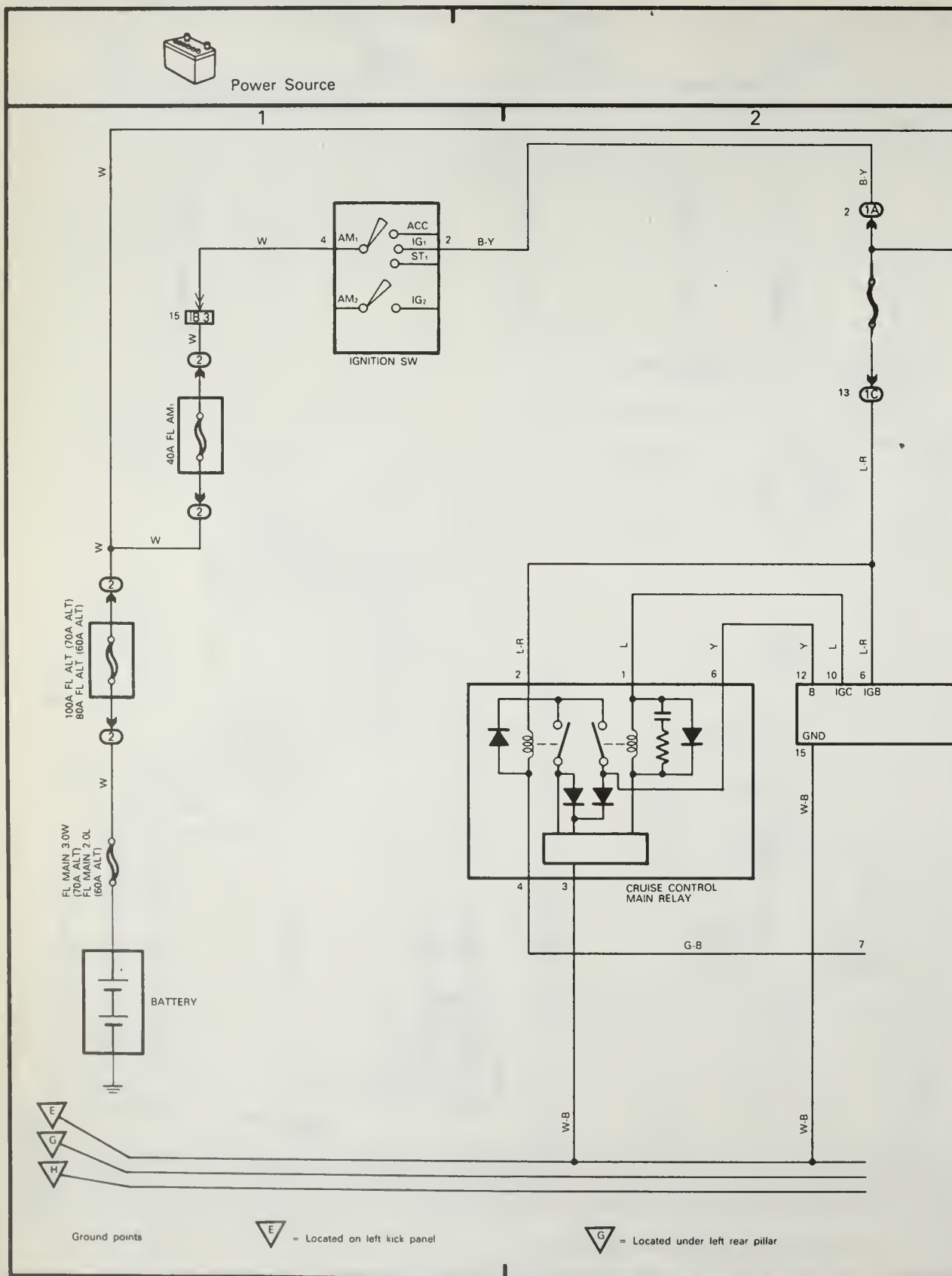


Wiring diagram — 1990 4Runner

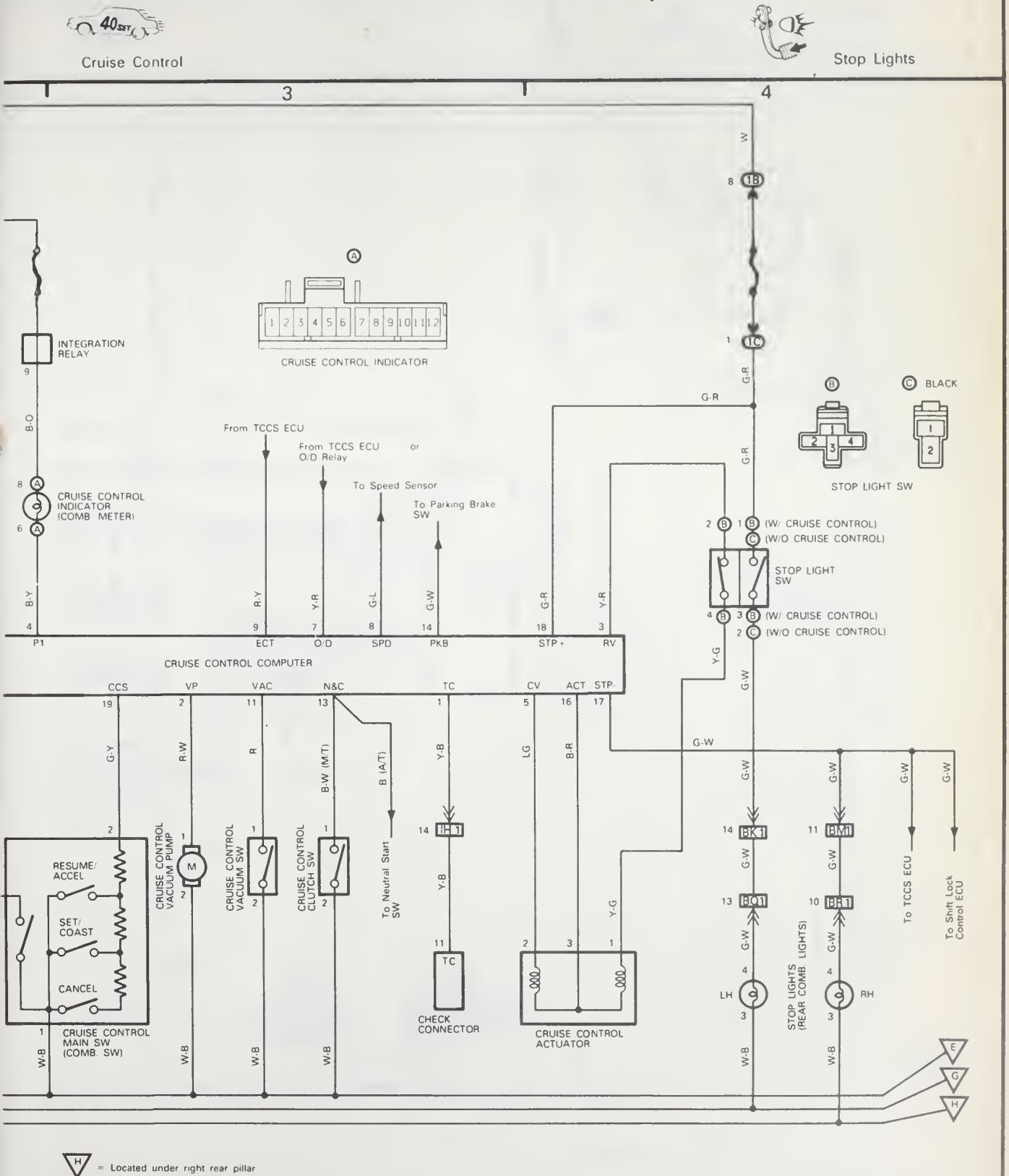


Wiring diagram — 1990 4Runner

6 CHASSIS ELECTRICAL

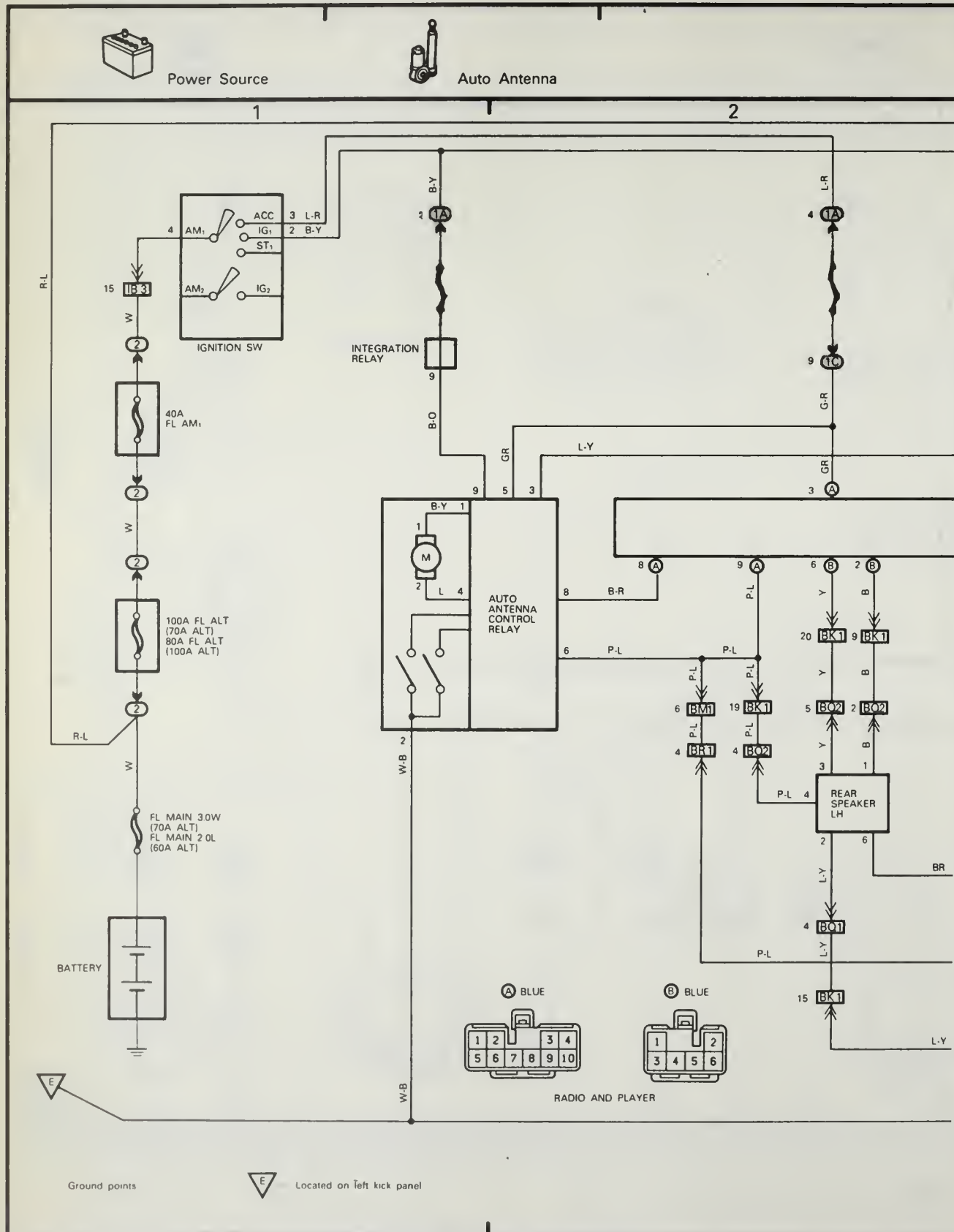


Wiring diagram — 1990 4Runner

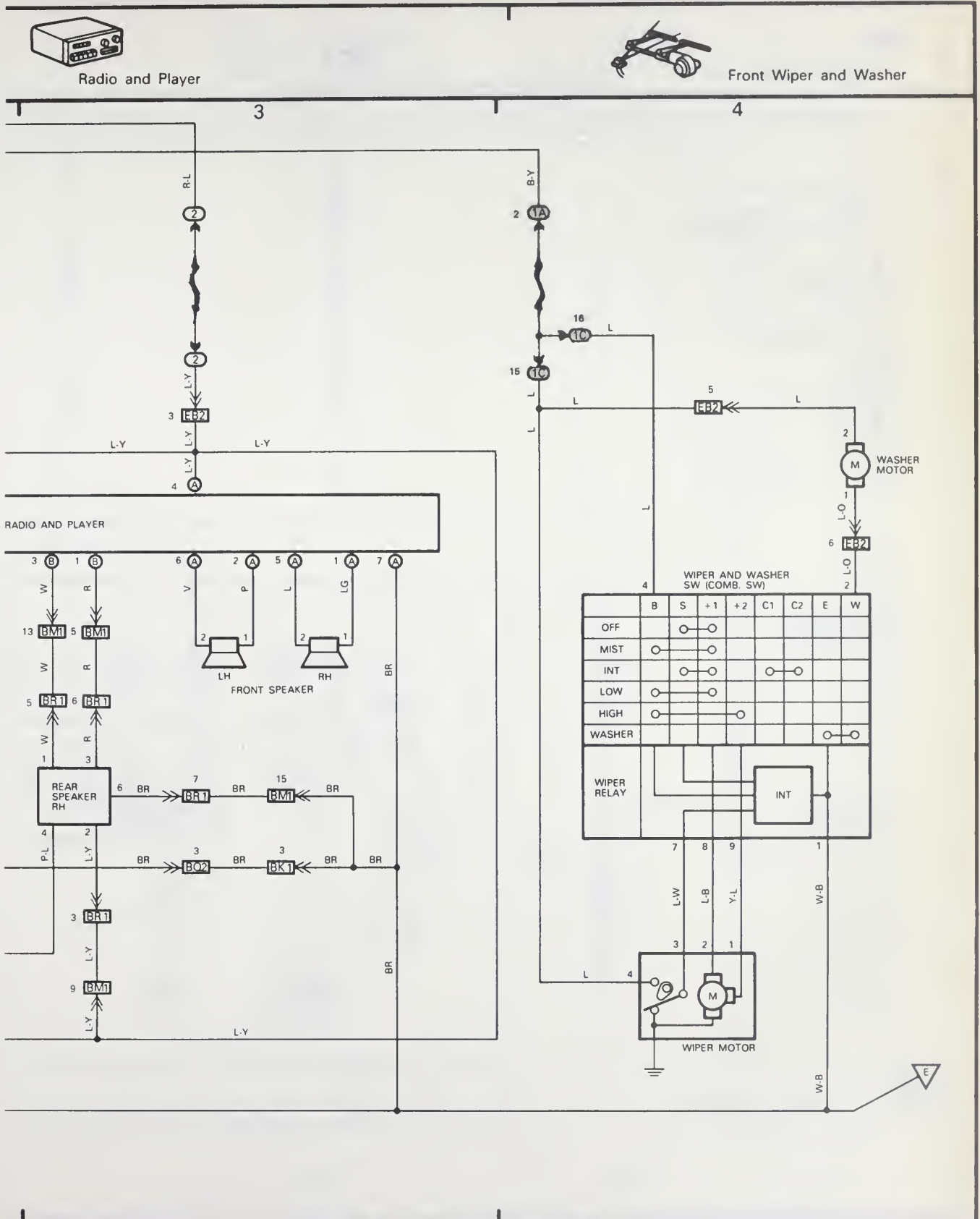


Wiring diagram – 1990 4Runner

6 CHASSIS ELECTRICAL



Wiring diagram — 1990 4Runner

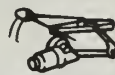


Wiring diagram — 1990 4Runner

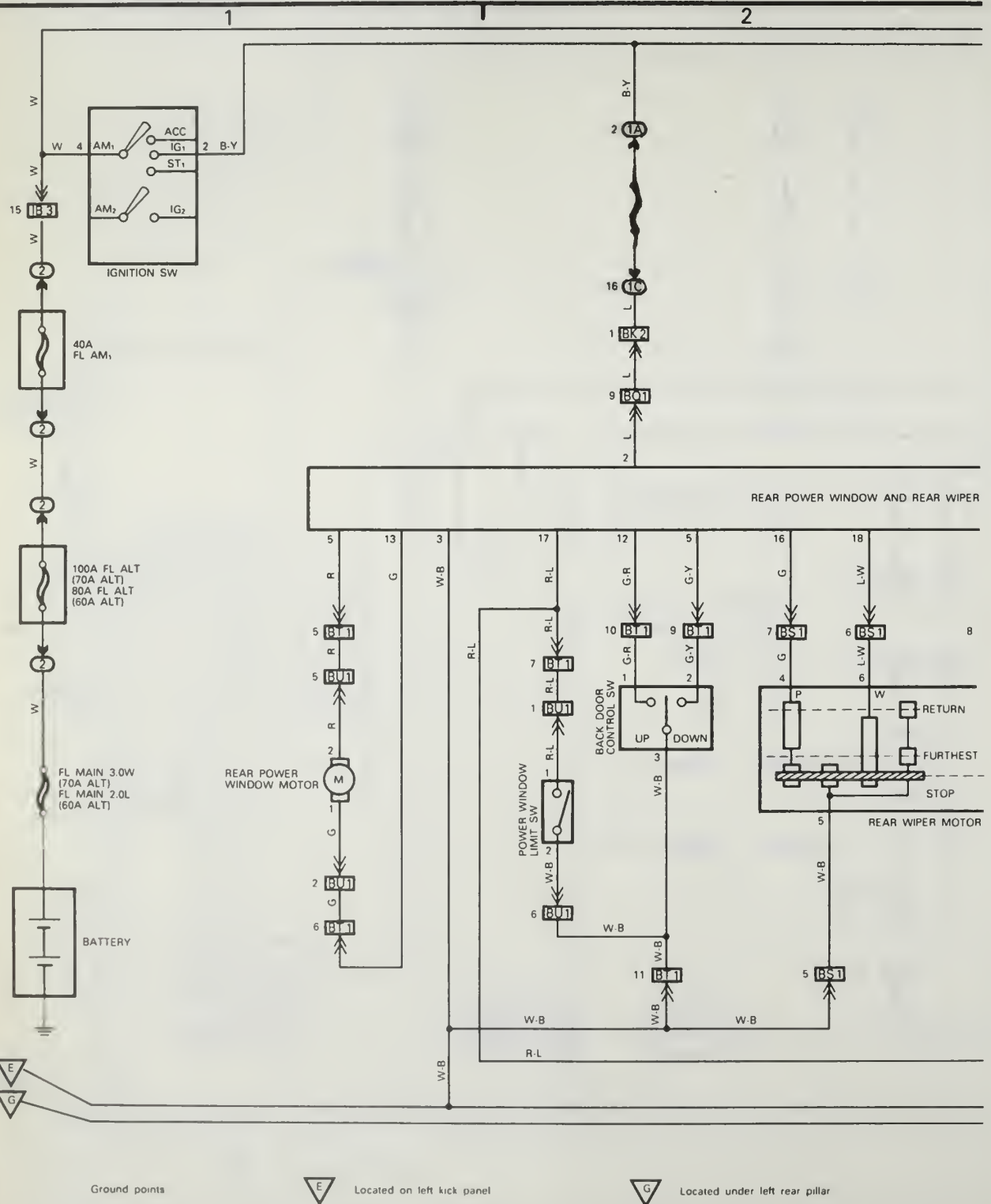
6 CHASSIS ELECTRICAL



Power Source

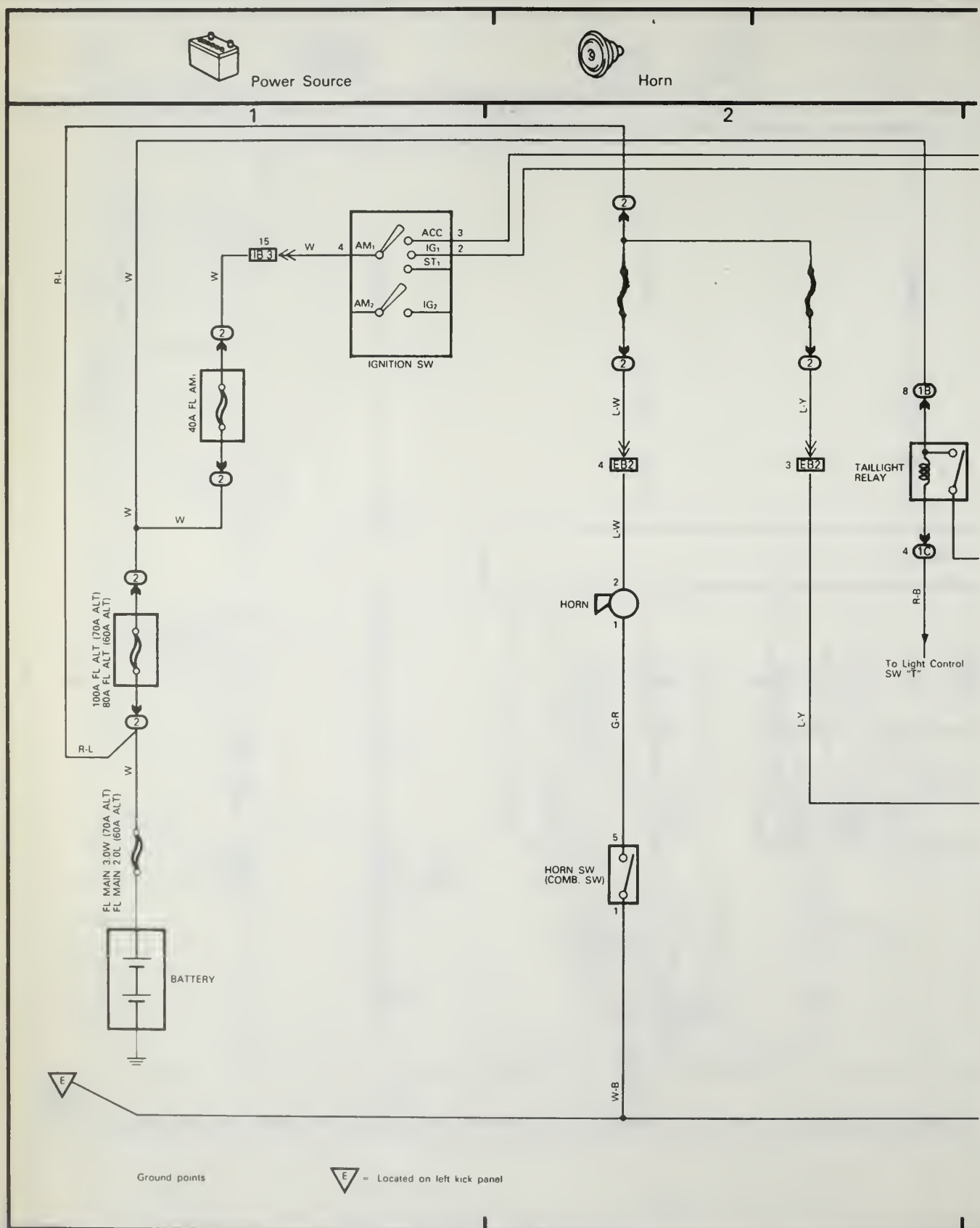


Rear Wiper, Washer and Power Window (Rear)



Wiring diagram — 1990 4Runner

6 CHASSIS ELECTRICAL



Wiring diagram — 1990 4Runner

CHASSIS ELECTRICAL 6



Clock



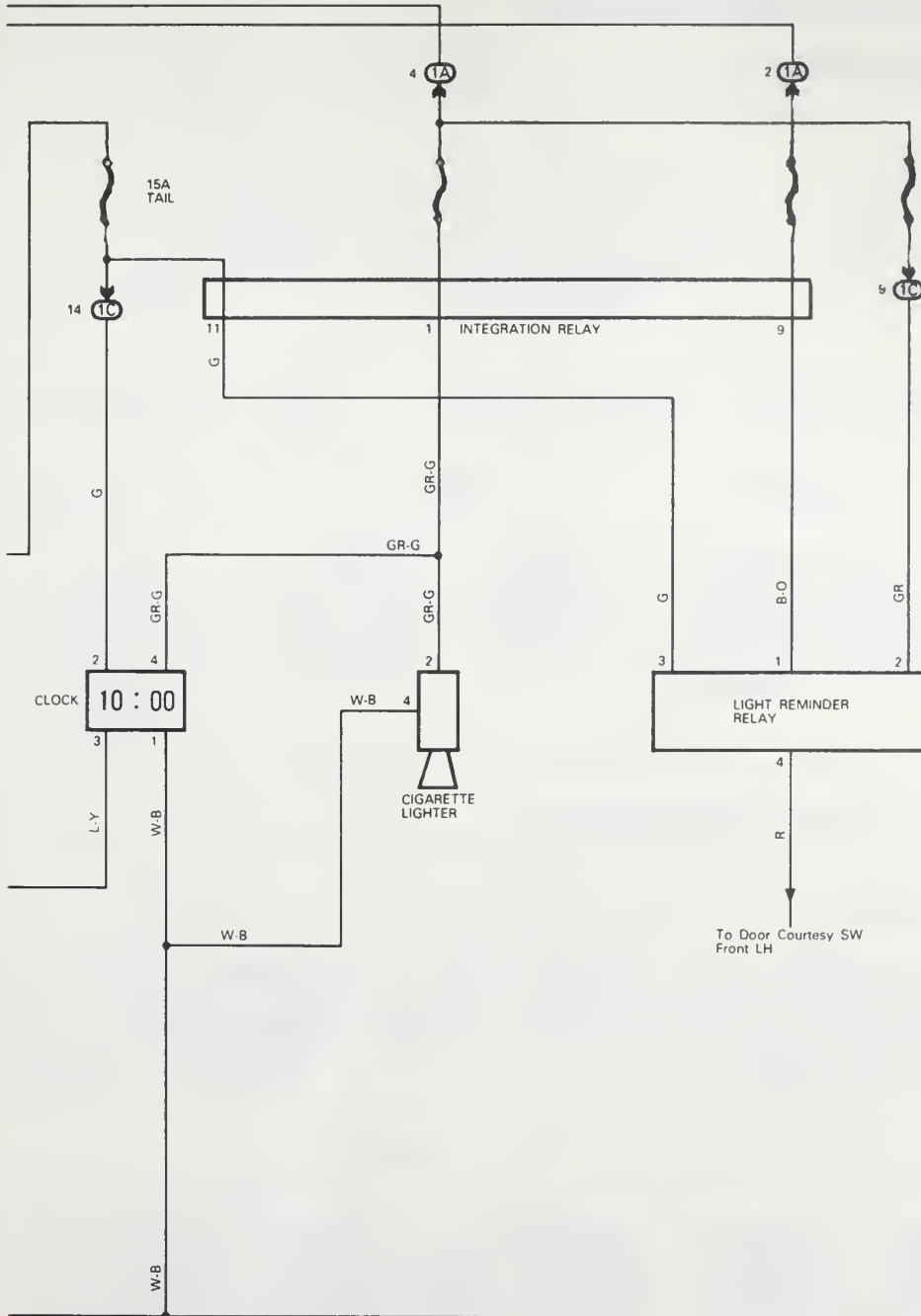
Cigarette Lighter



Light Reminder

3

4



Wiring diagram – 1990 4Runner

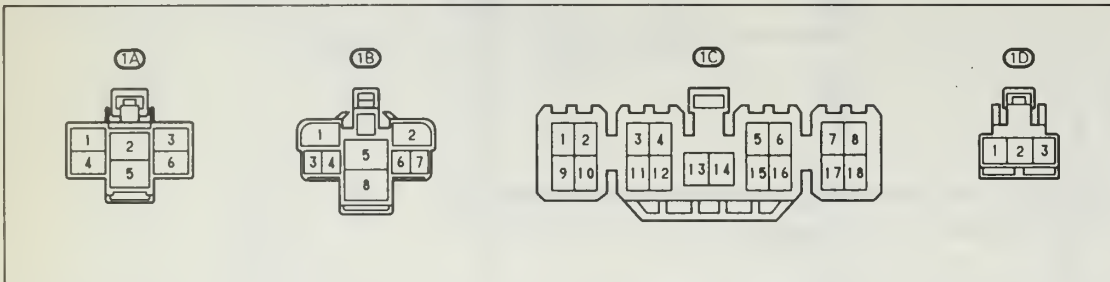
6 CHASSIS ELECTRICAL

1

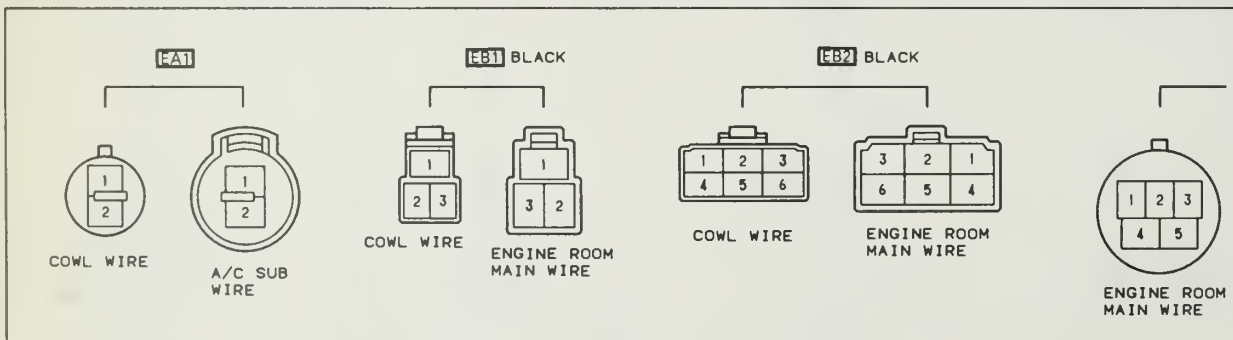
2

Junction Block and Wire Harness Connector

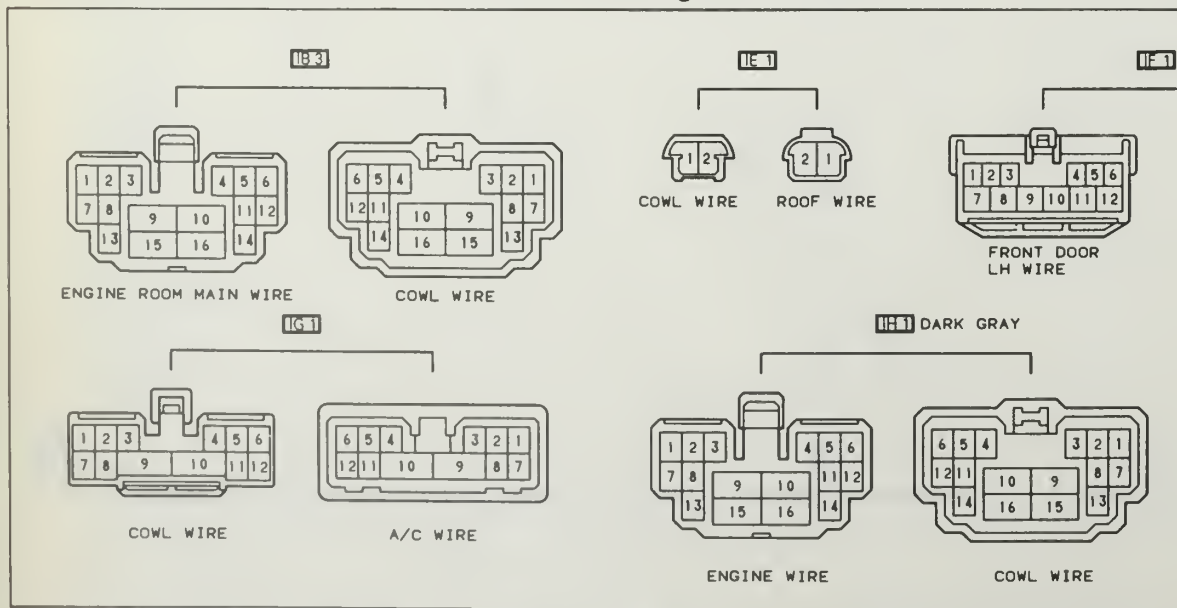
J/B NO. 1 (LEFT KICK PANEL)



Connector Joining Wire Harness and Wire Harness Engine Compartment area



I Group: Instrument Panel and Surrounding area



Wiring diagram — 1990 4Runner

3

4

(E01) BLACK



ALTERNATOR WIRE

(E02)



ENGINE ROOM MAIN WIRE



ALTERNATOR WIRE

(3VZ-E) (E01) BLACK



SENSOR WIRE



ENGINE WIRE

(1F2)



FRONT DOOR LH WIRE



COWL WIRE

(1F3)



FRONT DOOR LH WIRE

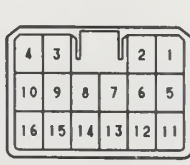


COWL WIRE

(1F2)

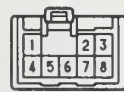


ENGINE WIRE



COWL WIRE

(1F1)



FRONT DOOR RH WIRE



COWL WIRE

(1F2)



FRONT DOOR RH WIRE



COWL WIRE

Wiring diagram — 1990 4Runner

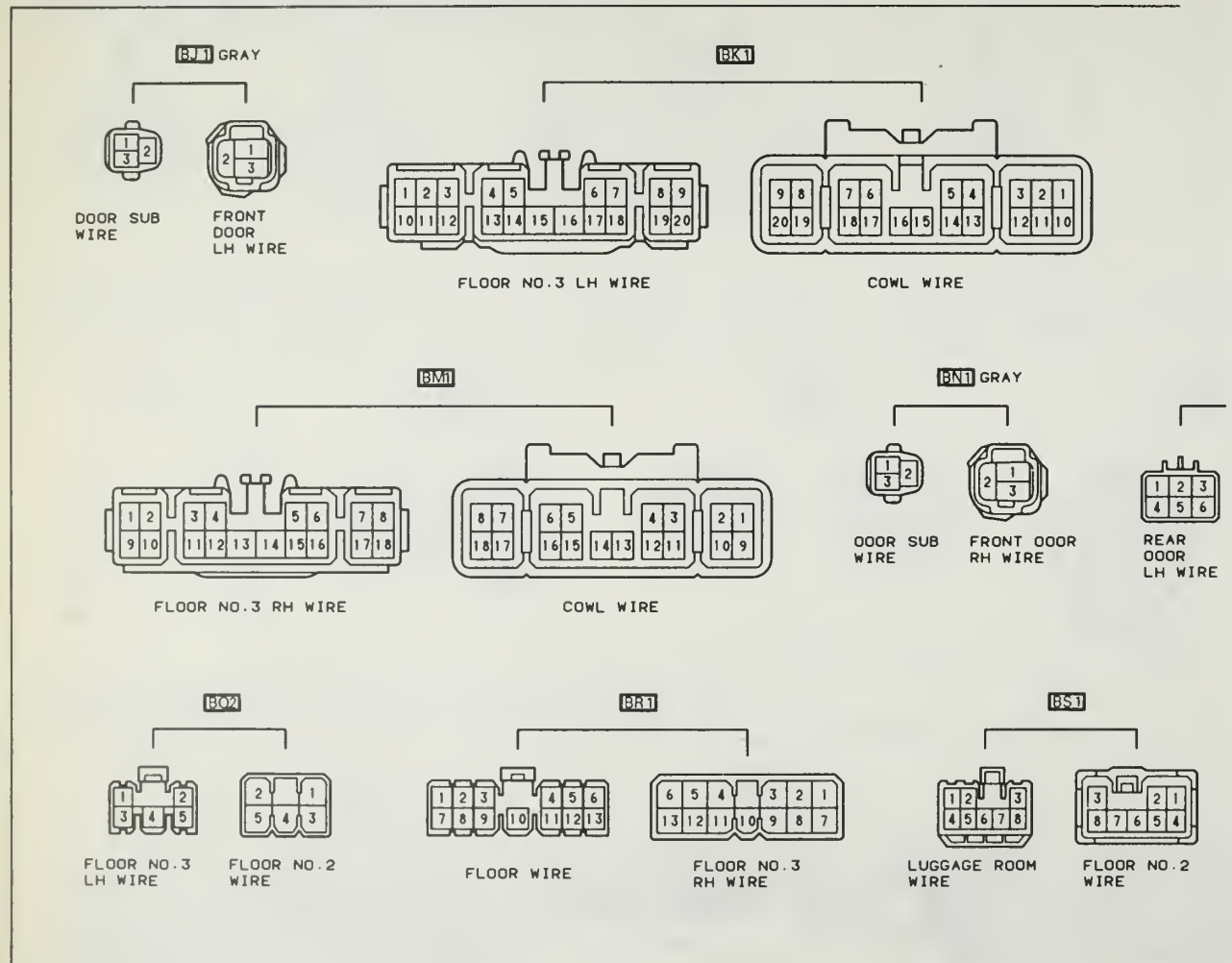
6 CHASSIS ELECTRICAL

1

2

Connector Joining Wire Harness and Wire Harness

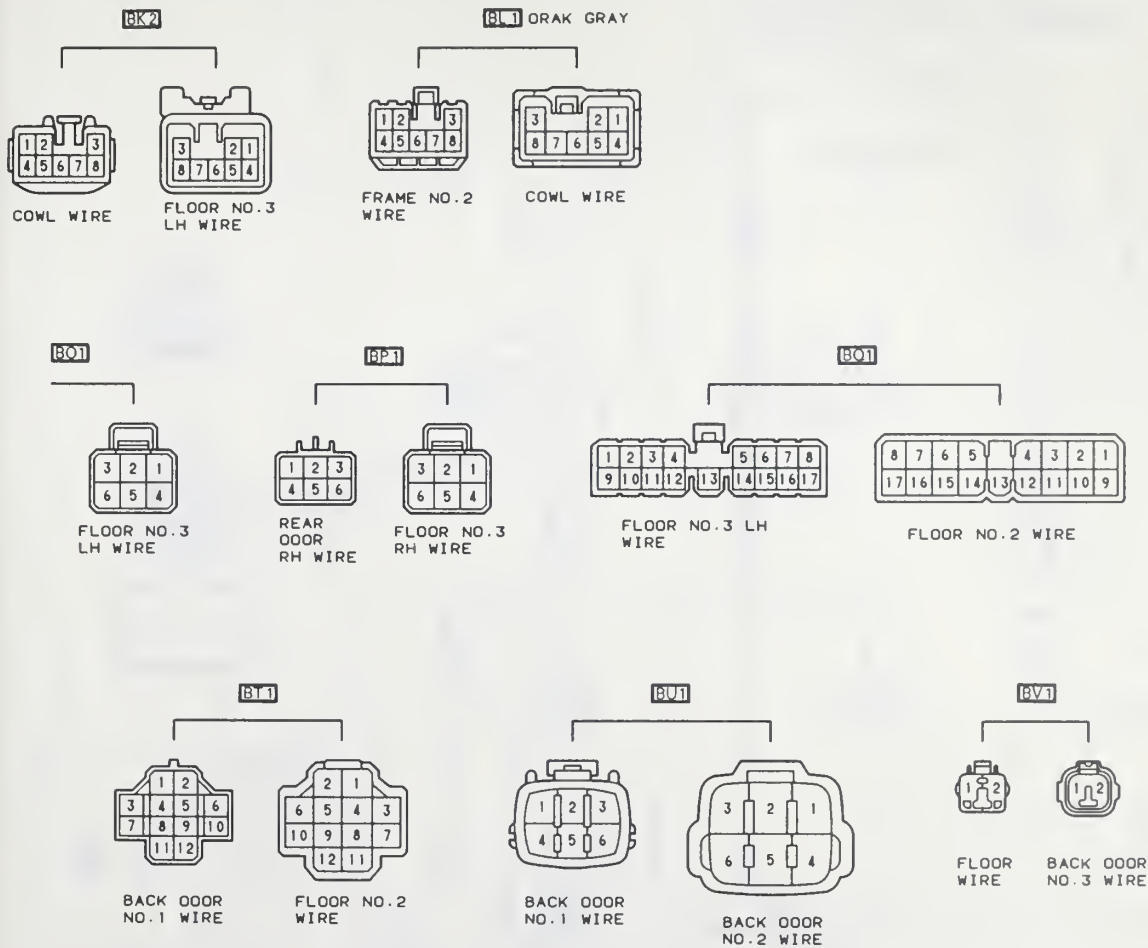
(B Group: Body and Surrounding area)



Wiring diagram — 1990 4Runner

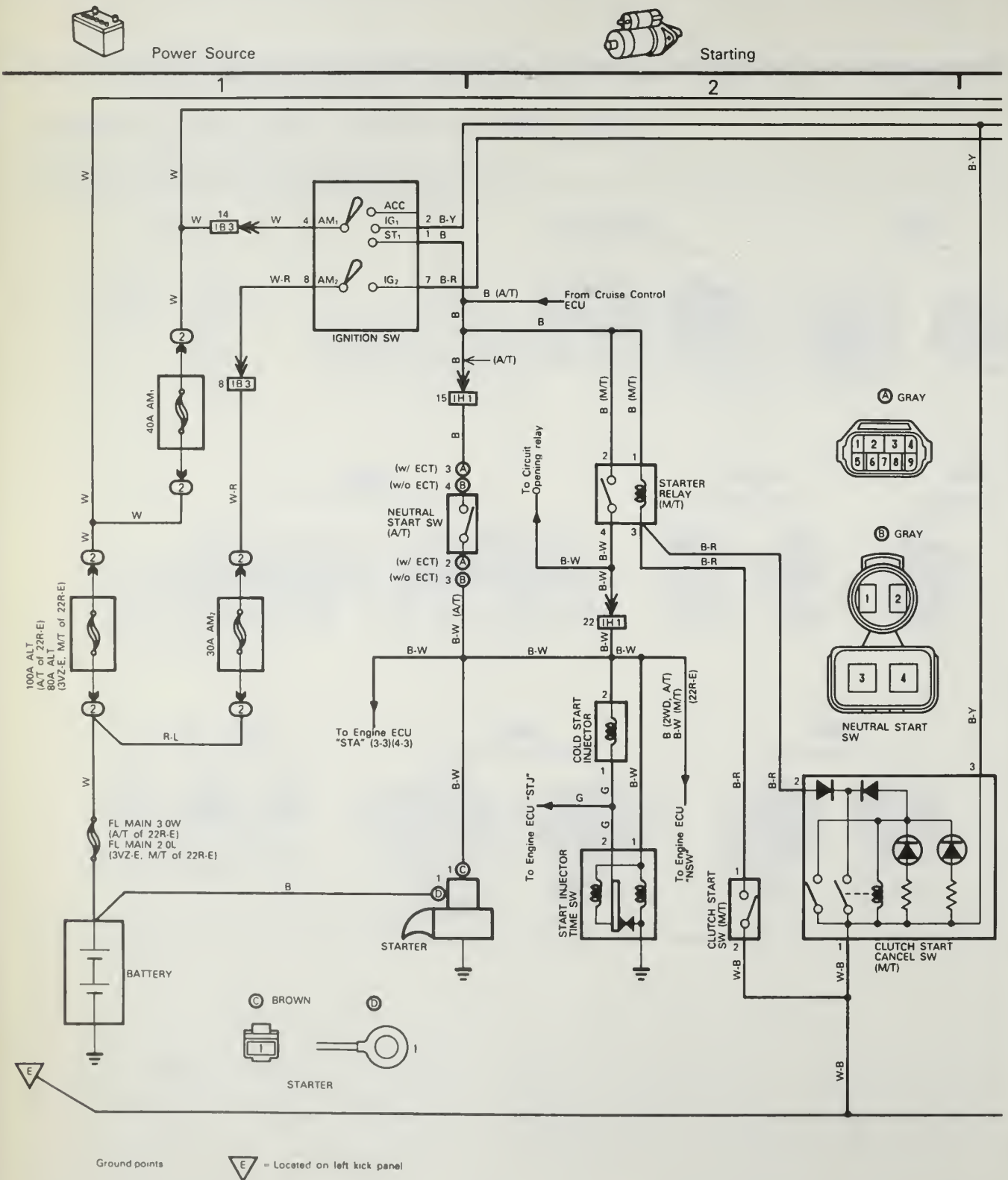
3

4

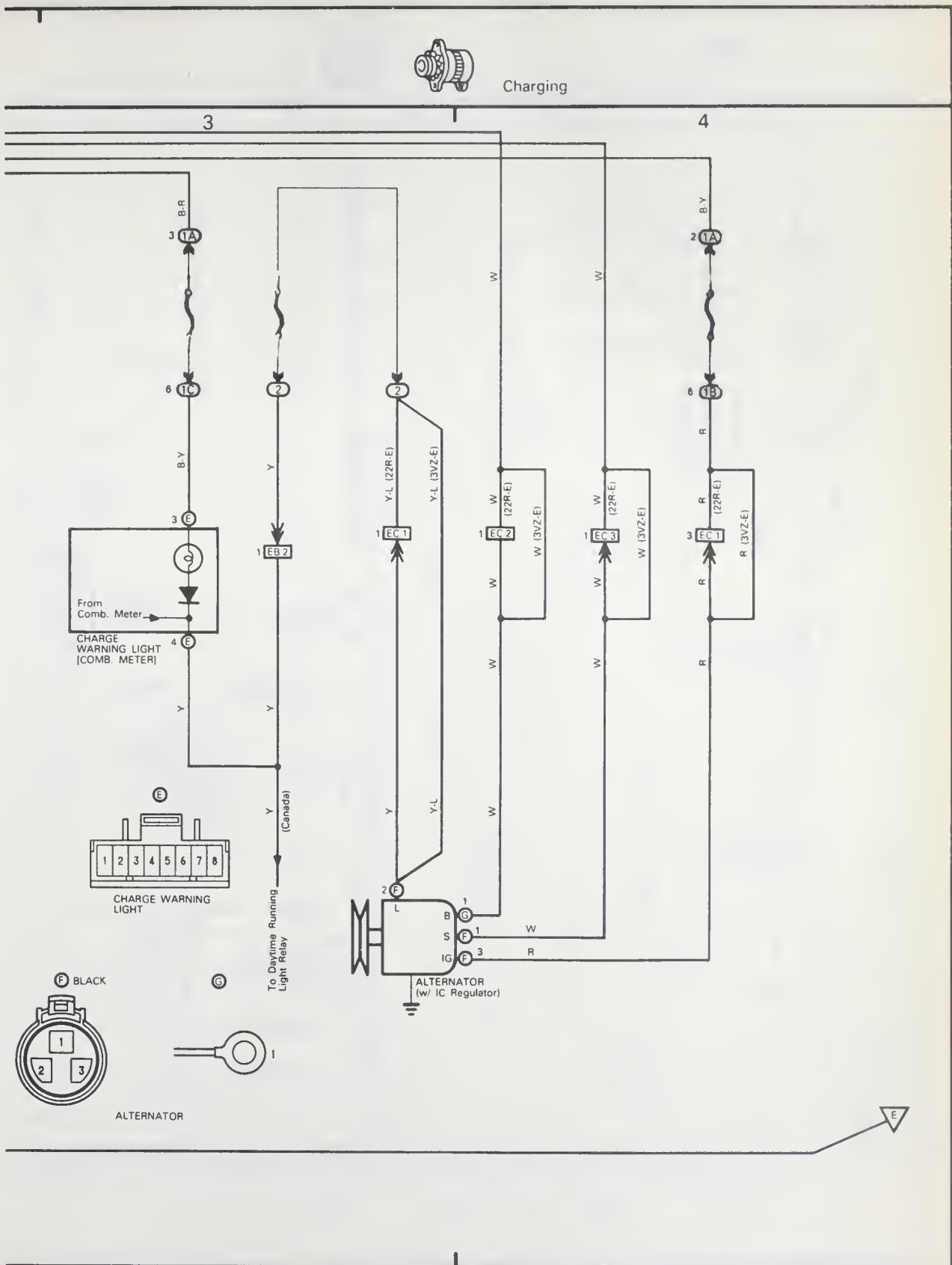


Wiring diagram — 1990 4Runner

6 CHASSIS ELECTRICAL

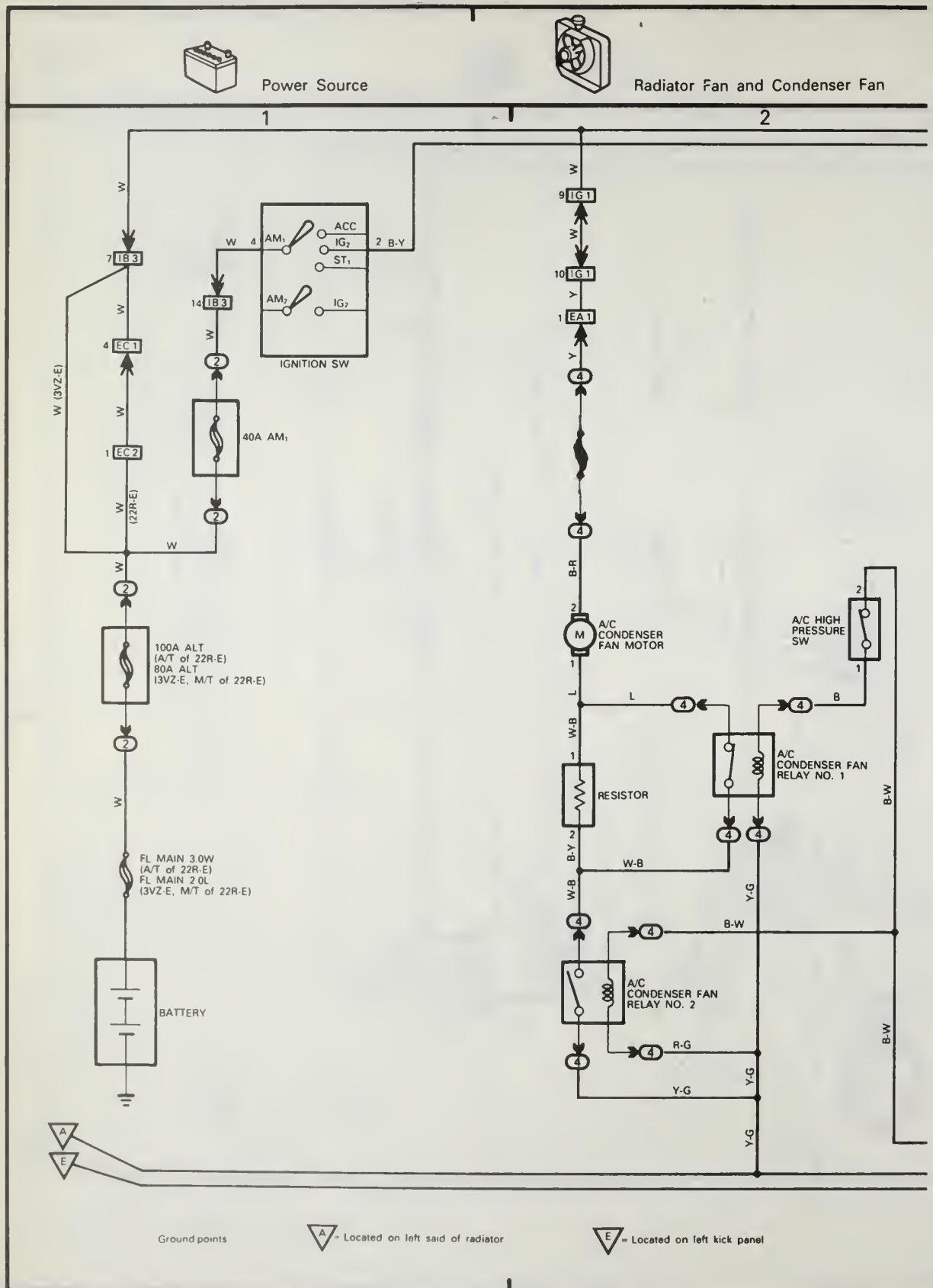


Wiring diagram — 1991 4Runner



Wiring diagram — 1991 4Runner

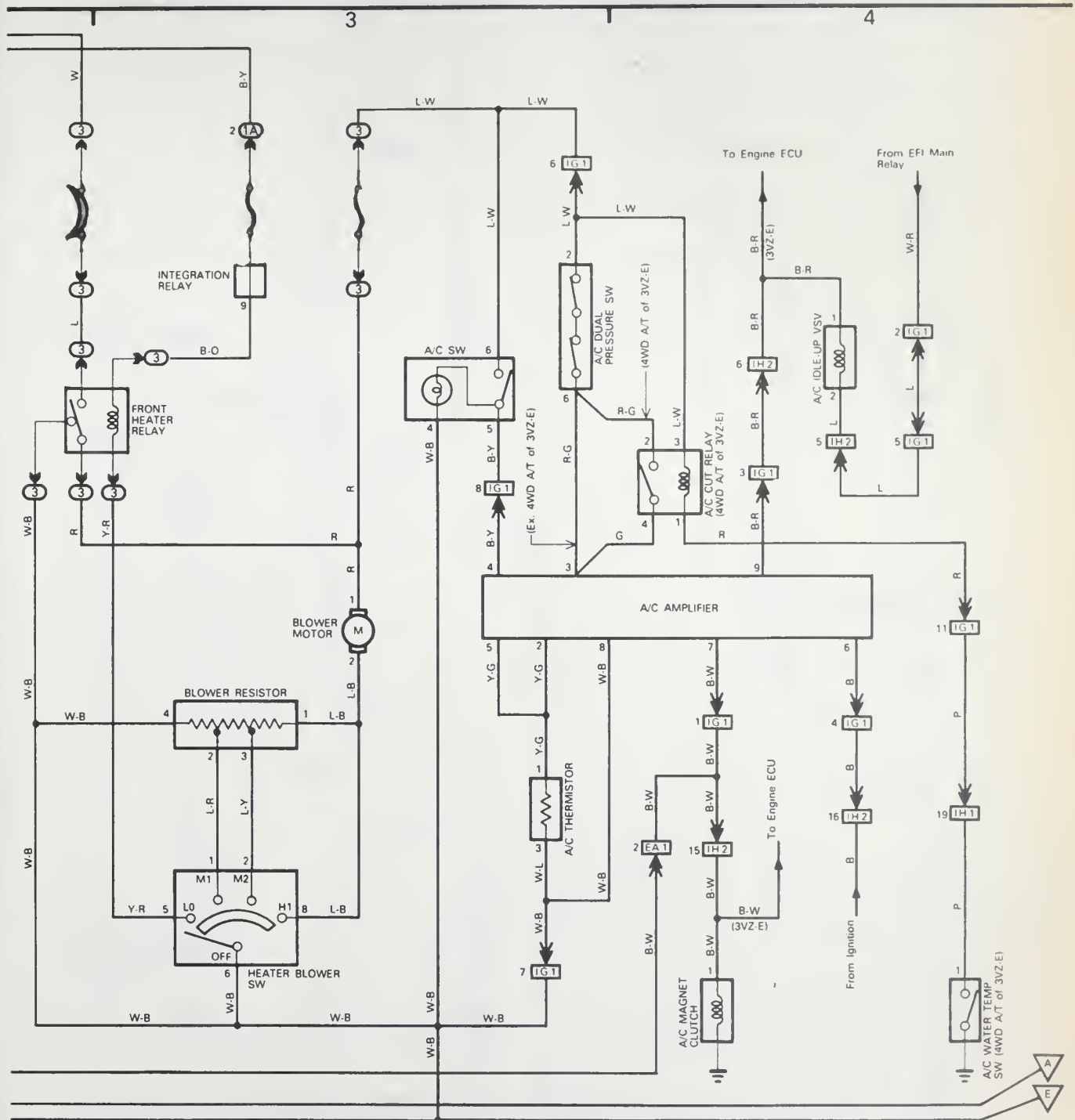
6 CHASSIS ELECTRICAL



Wiring diagram — 1991 4Runner

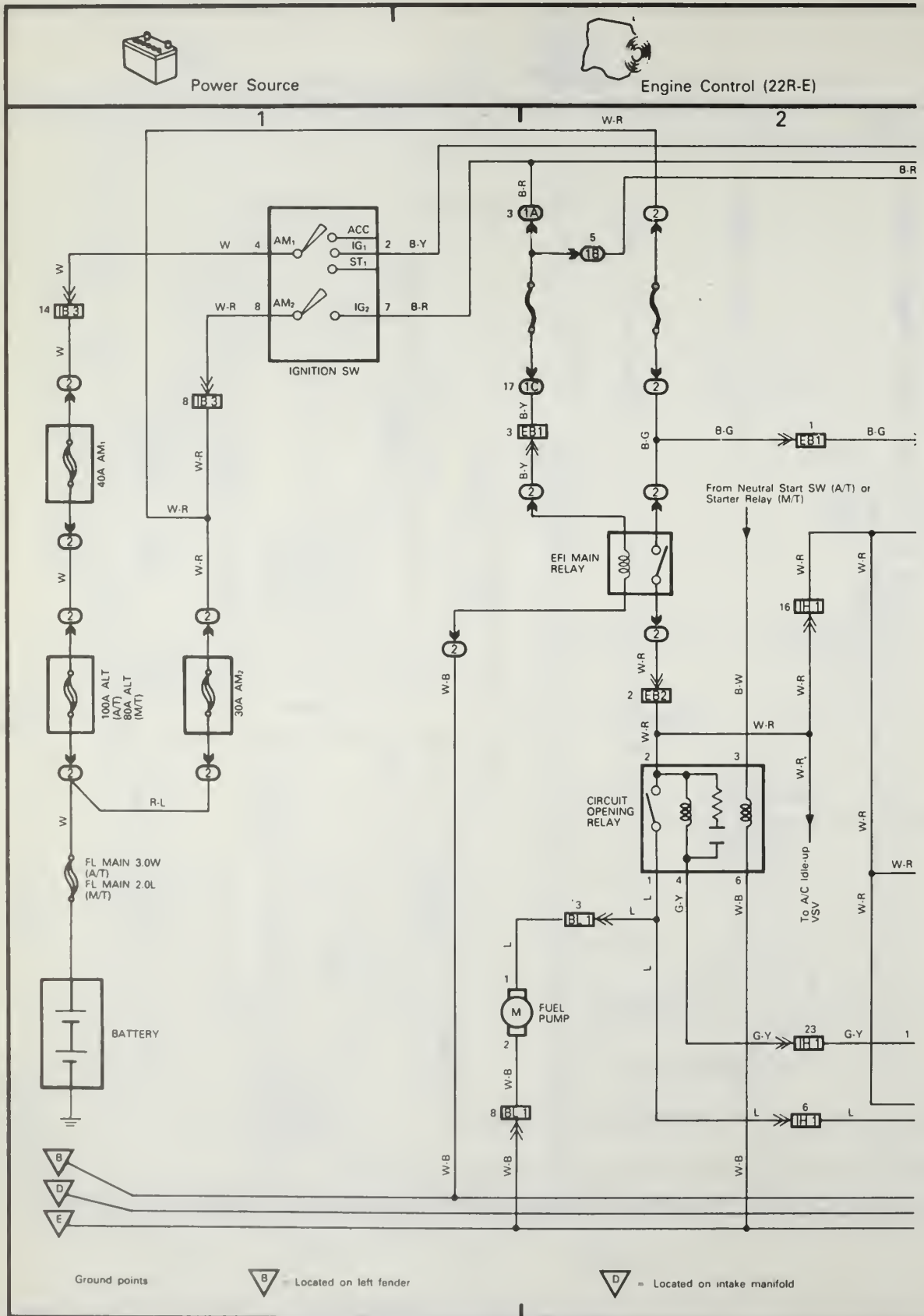


Air Conditioner, Cooler and Heater

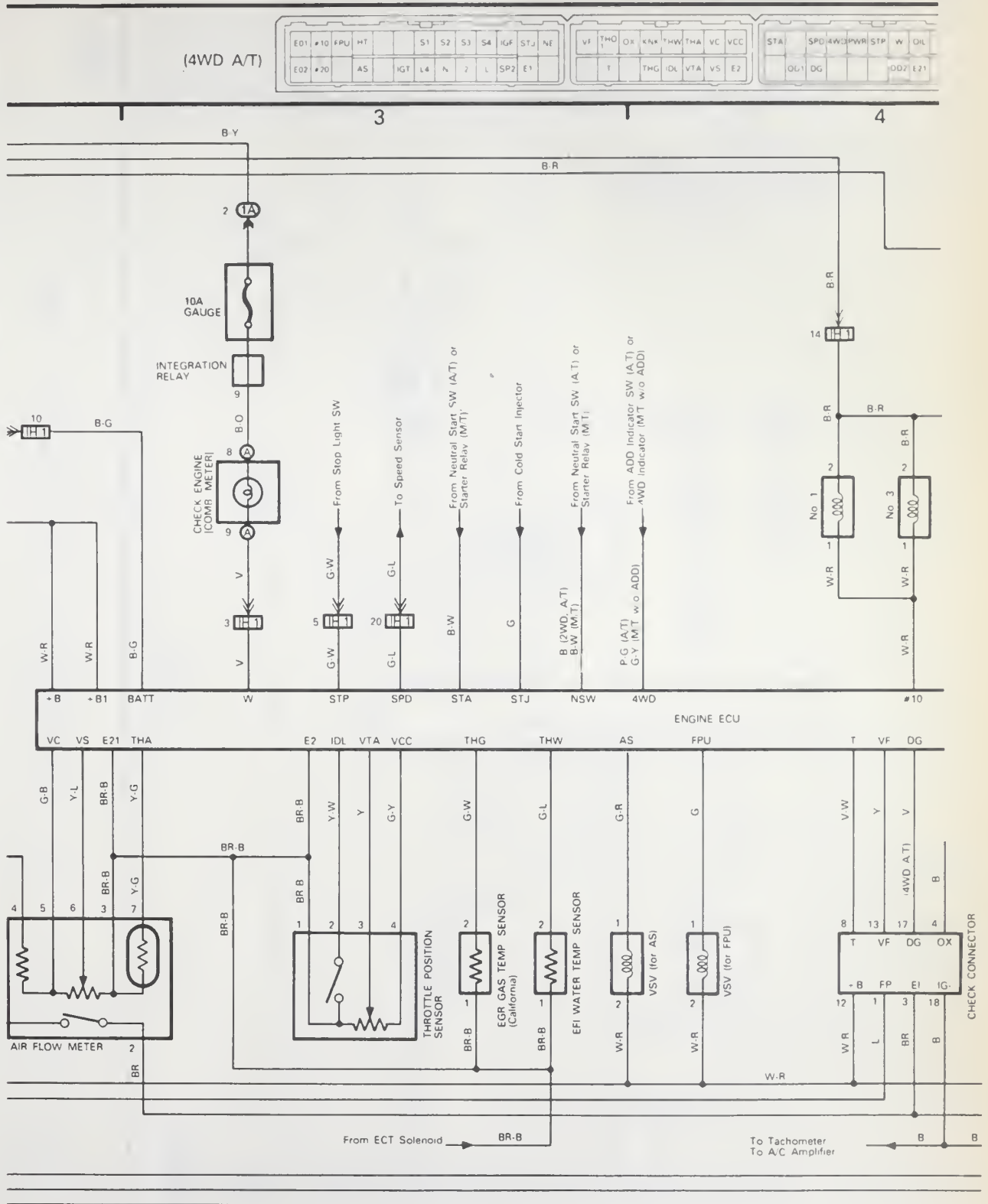


Wiring diagram - 1991 4Runner

6 CHASSIS ELECTRICAL

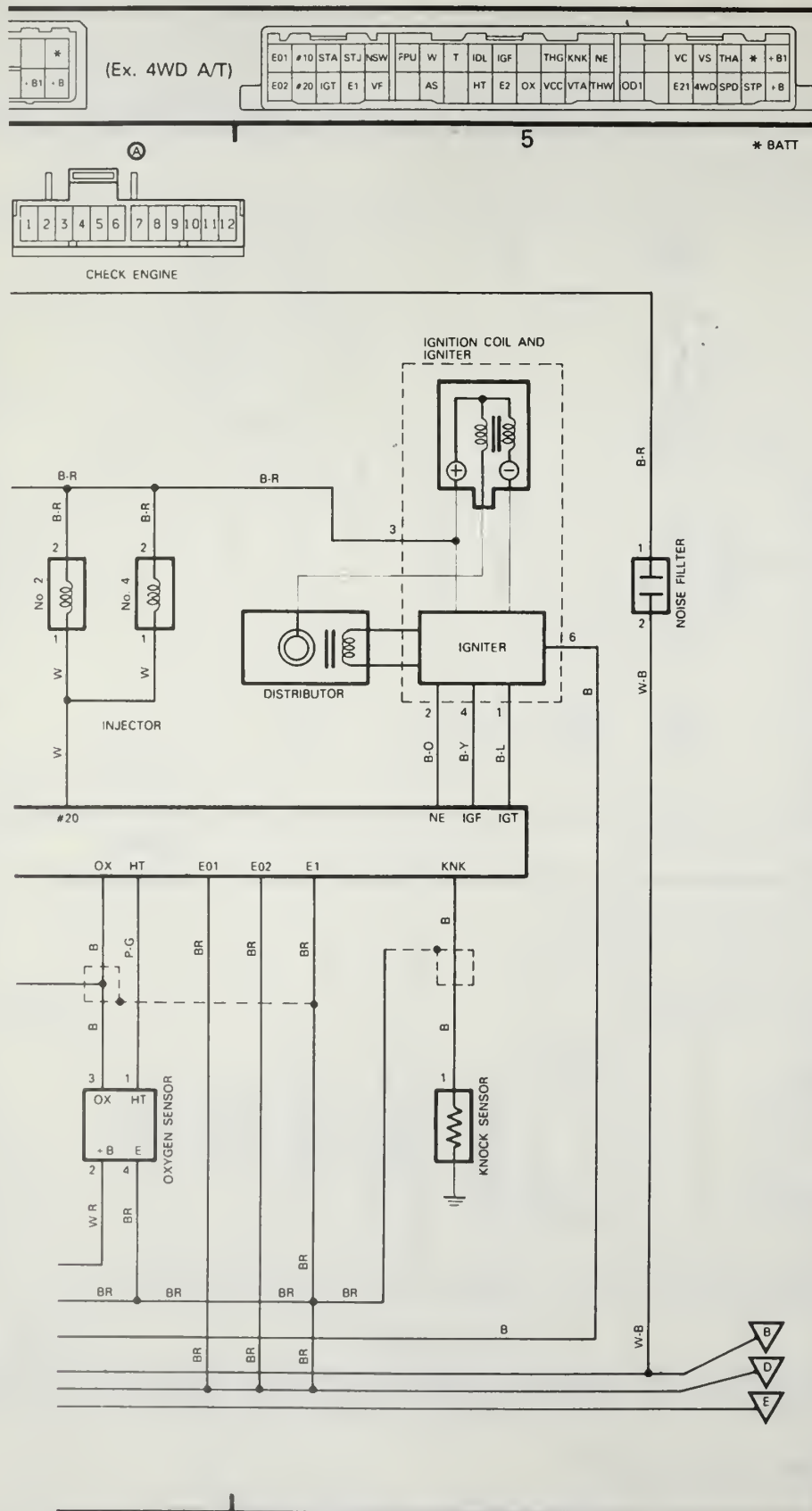


Wiring diagram – 1991 4Runner

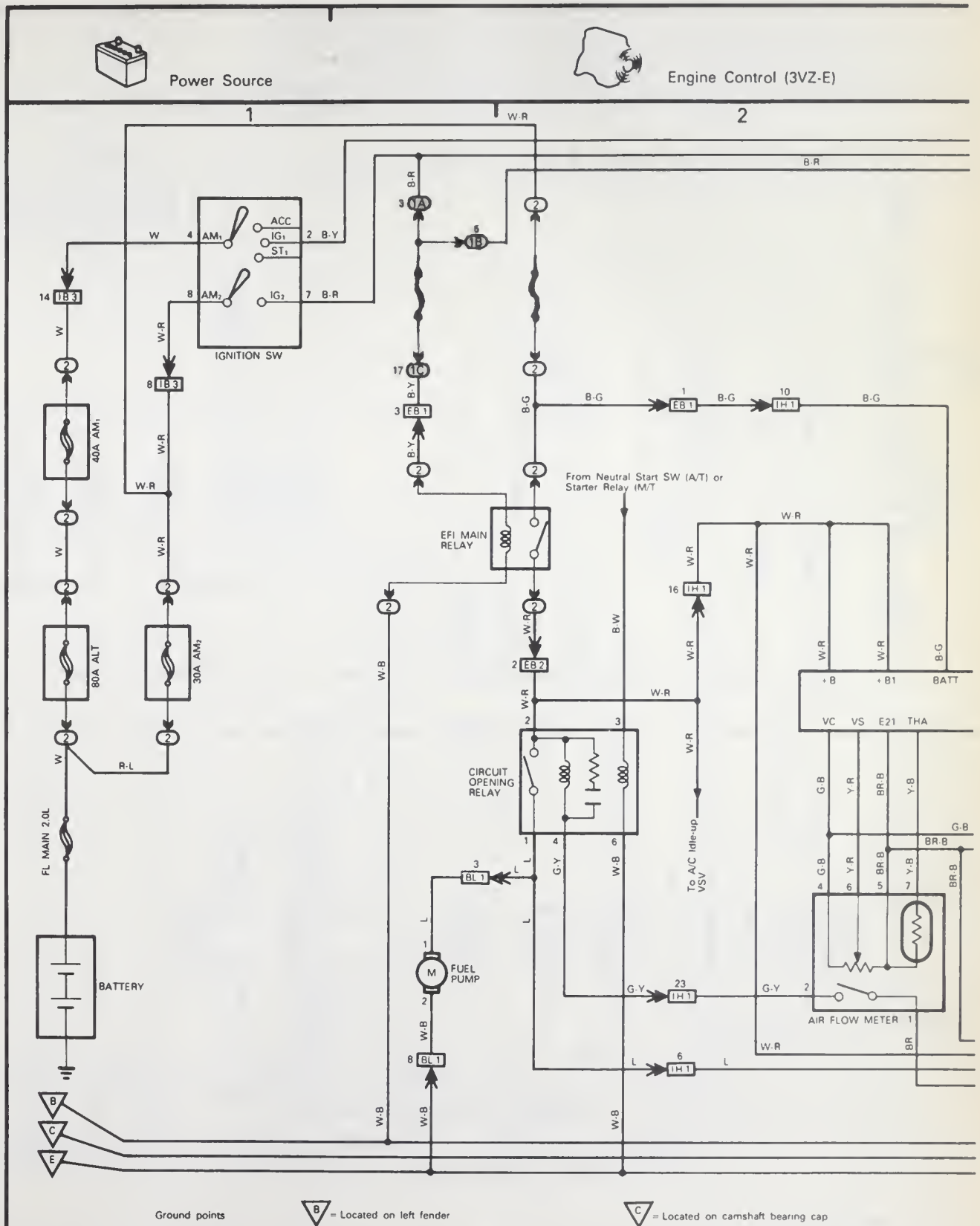


Wiring diagram – 1991 4Runner

6 CHASSIS ELECTRICAL

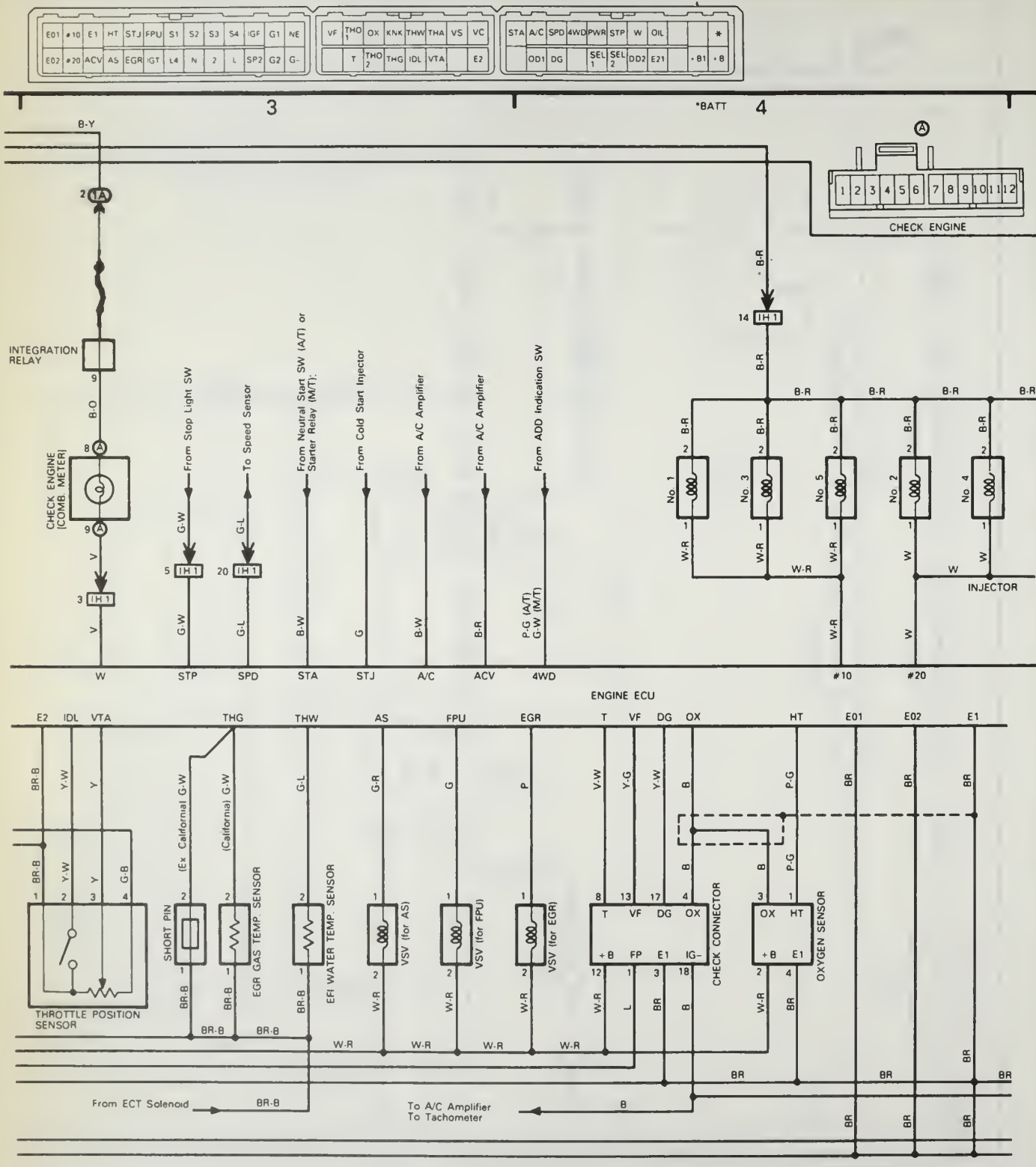


CHASSIS ELECTRICAL 6

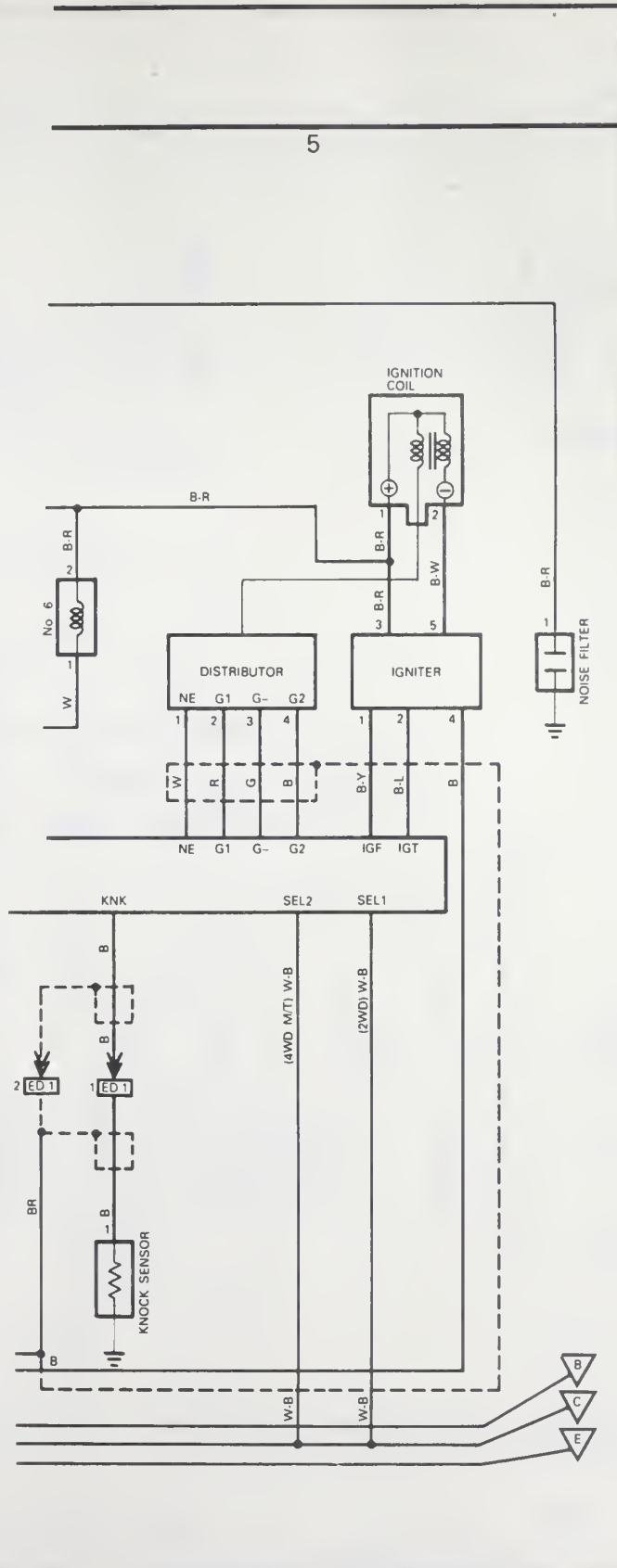


Wiring diagram — 1991 4Runner

6 CHASSIS ELECTRICAL

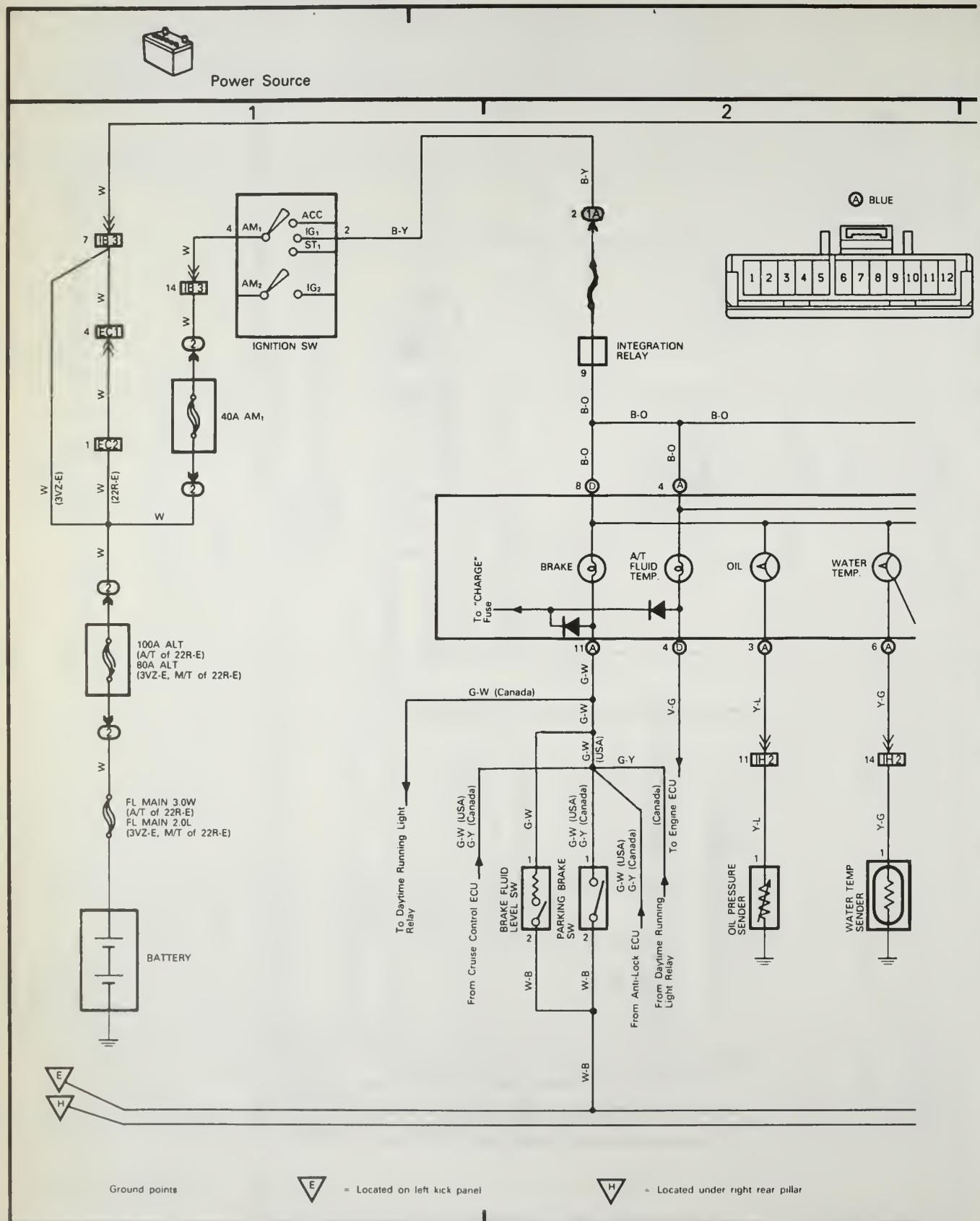


Wiring diagram — 1991 4Runner



Wiring diagram — 1991 4Runner

6 CHASSIS ELECTRICAL



Wiring diagram — 1991 4Runner

6



6-209

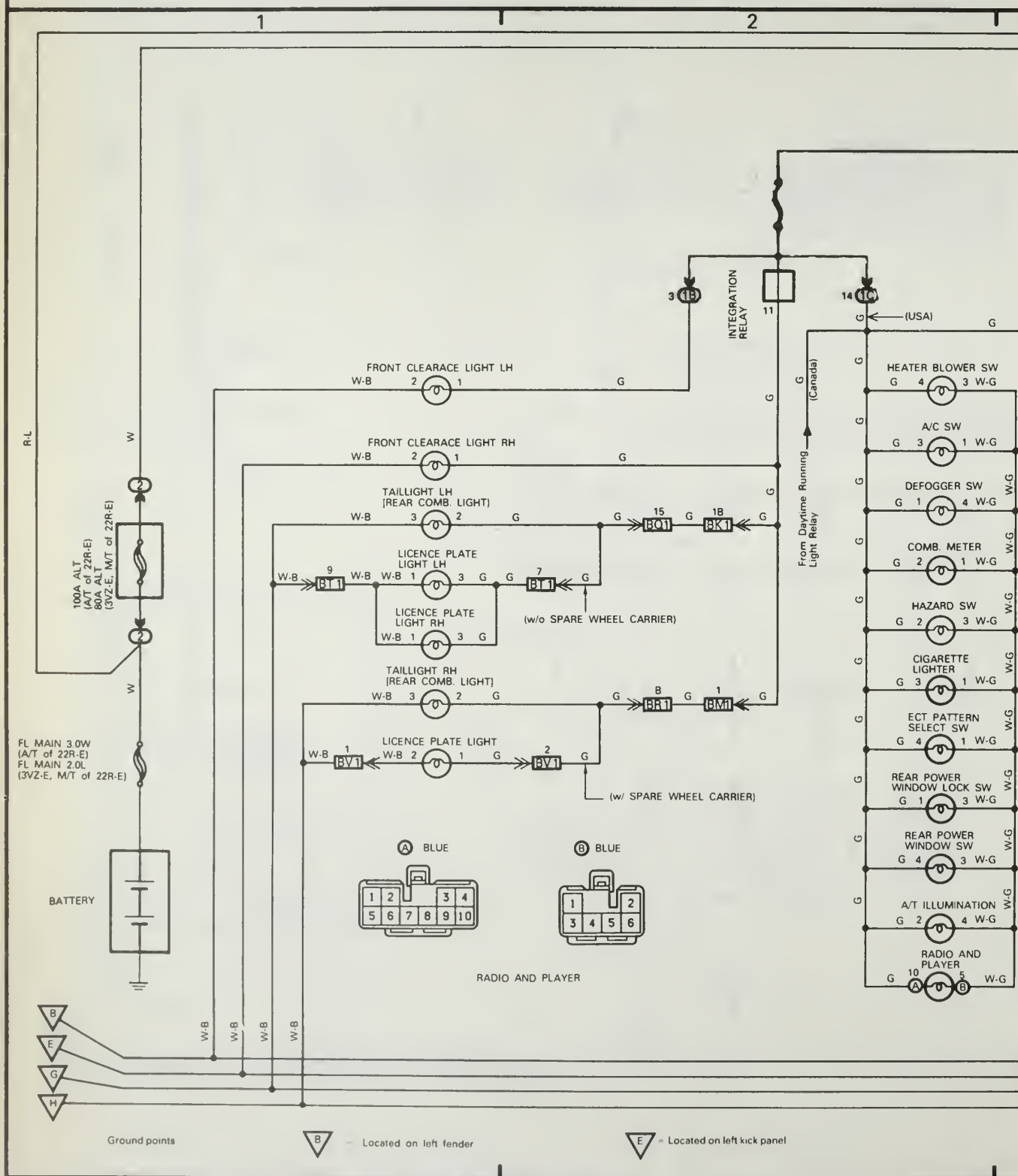
6 CHASSIS ELECTRICAL



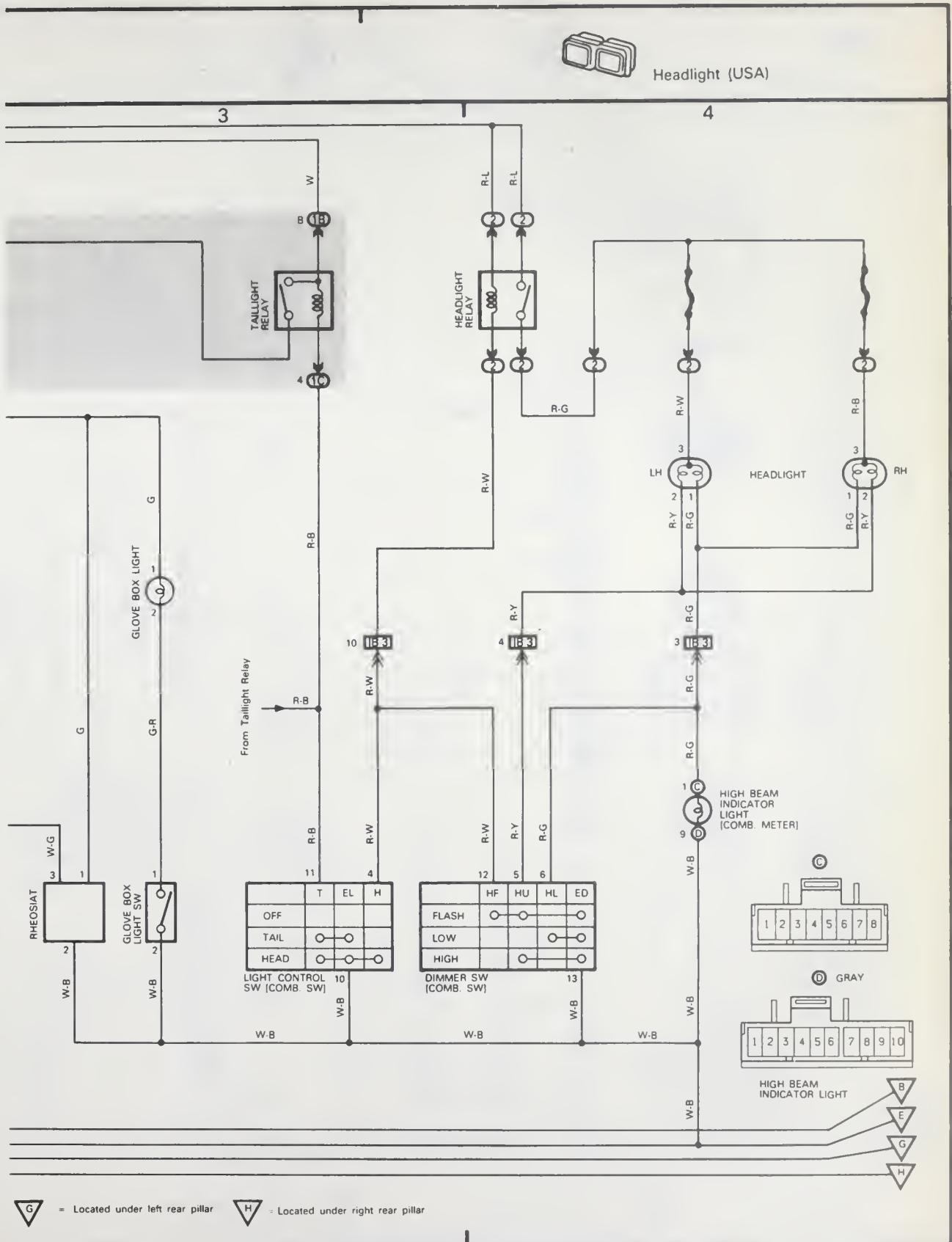
Power Source



Taillight and Illumination

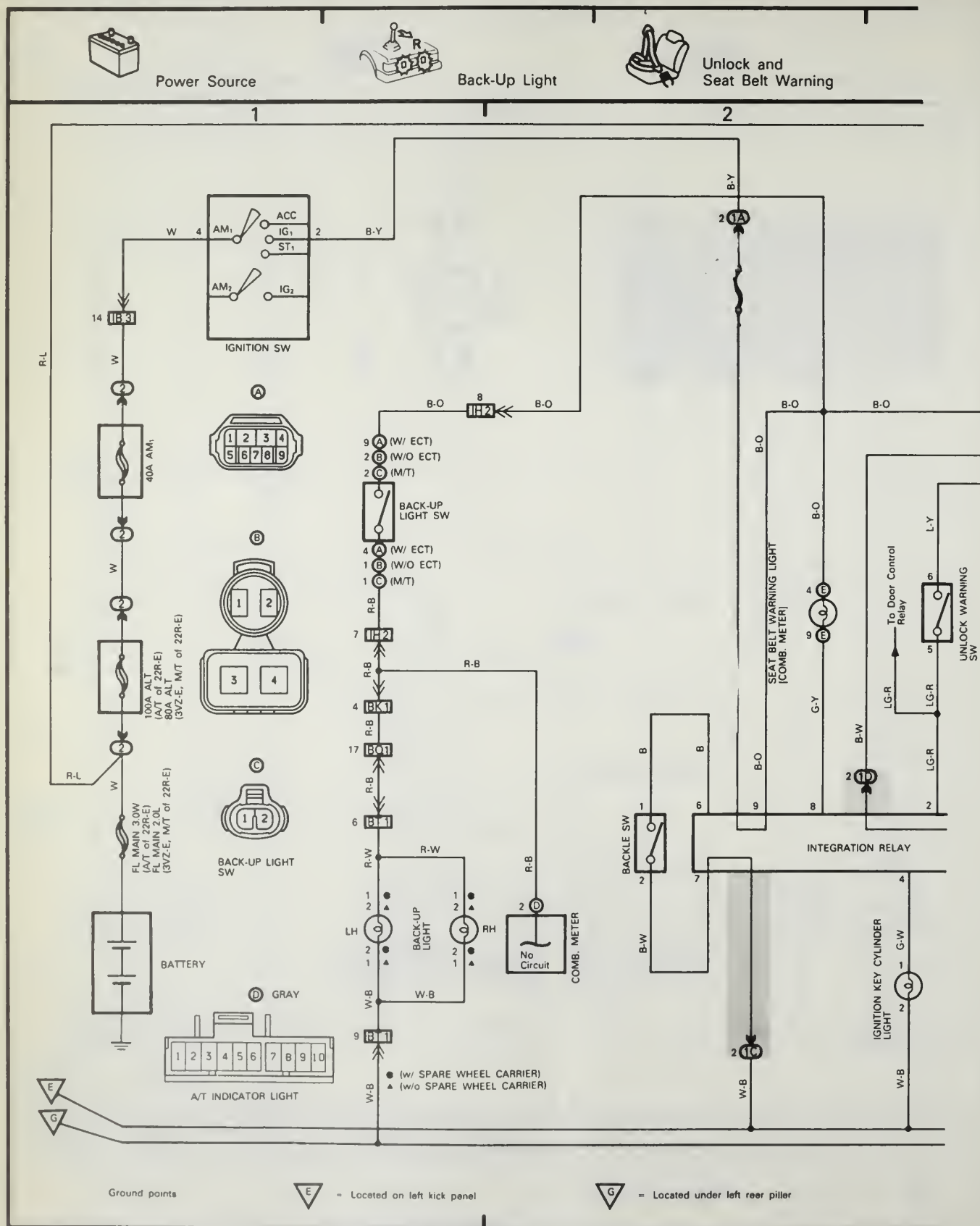


Wiring diagram — 1991 4Runner



Wiring diagram — 1991 4Runner

6 CHASSIS ELECTRICAL

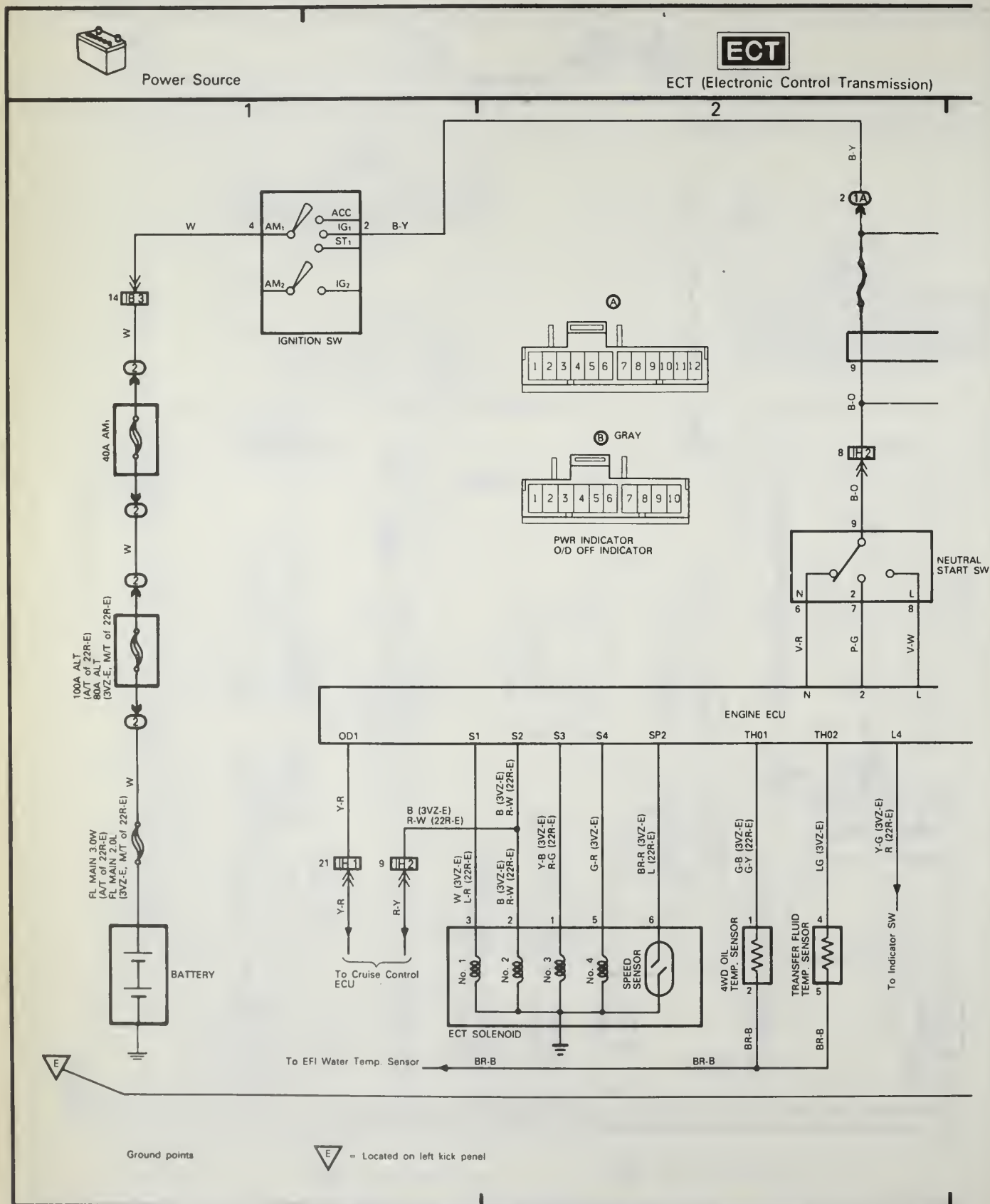


Wiring diagram — 1991 4Runner

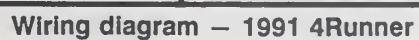


6-213

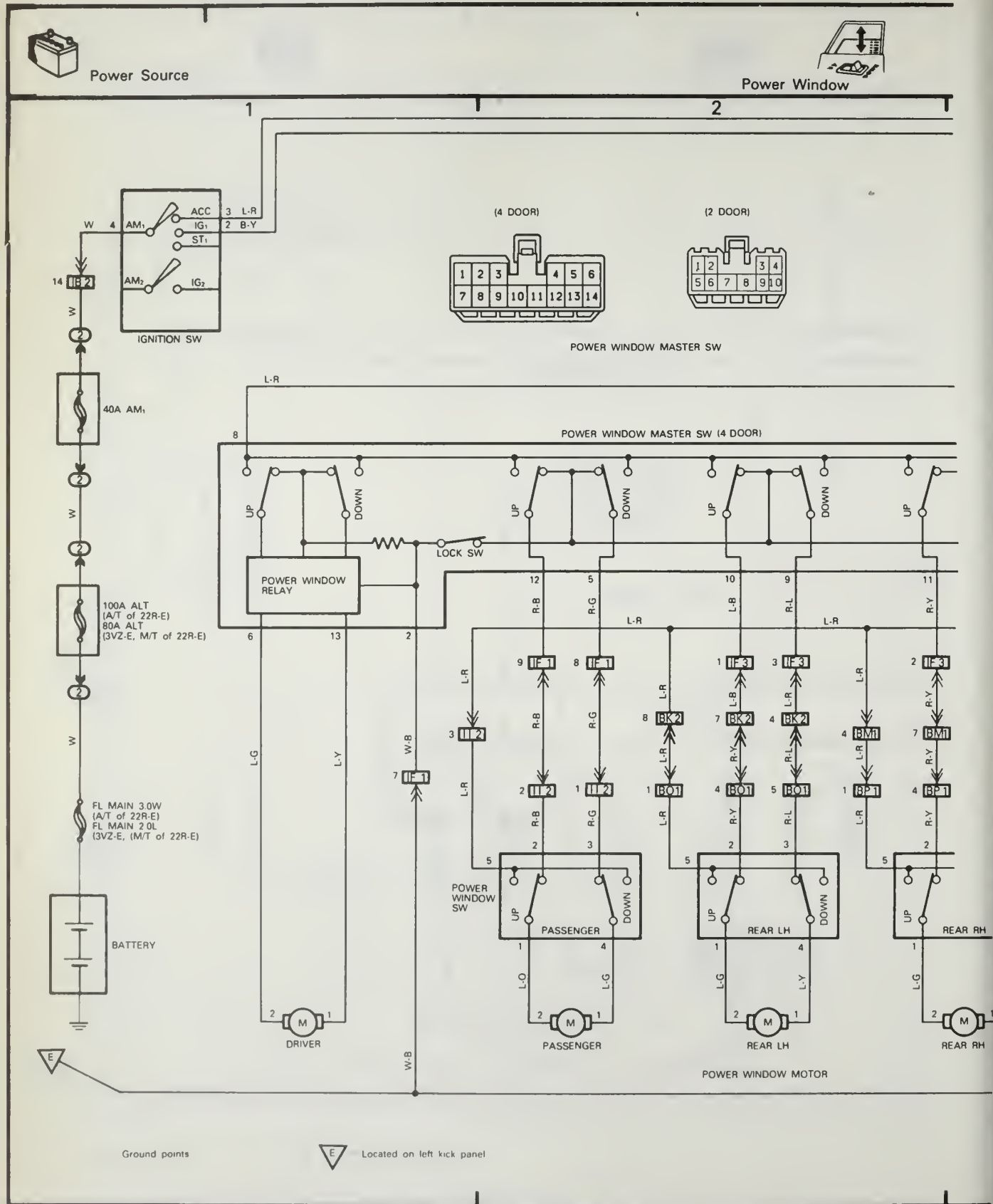
6 CHASSIS ELECTRICAL



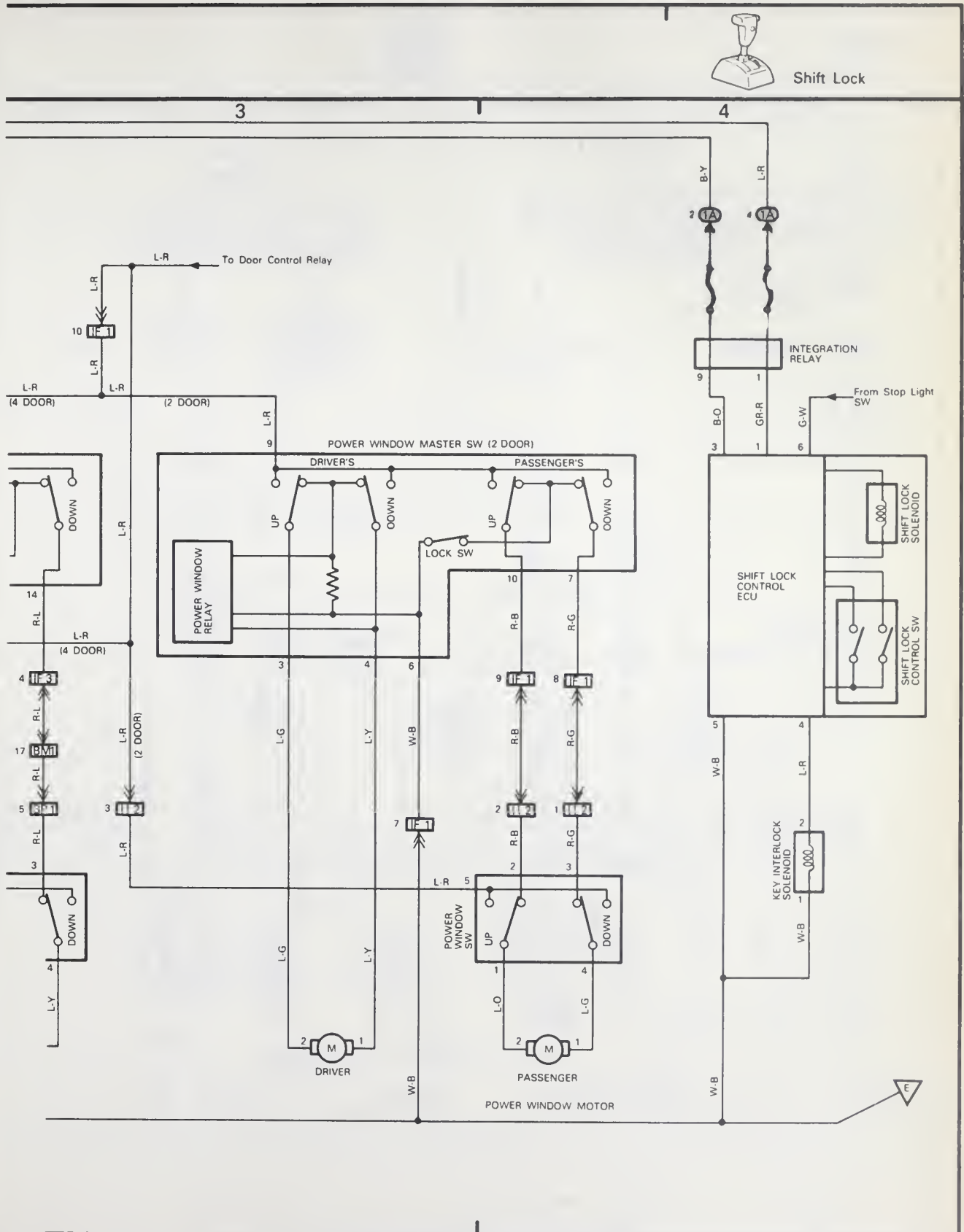
Wiring diagram — 1991 4Runner



6 CHASSIS ELECTRICAL

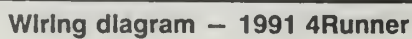


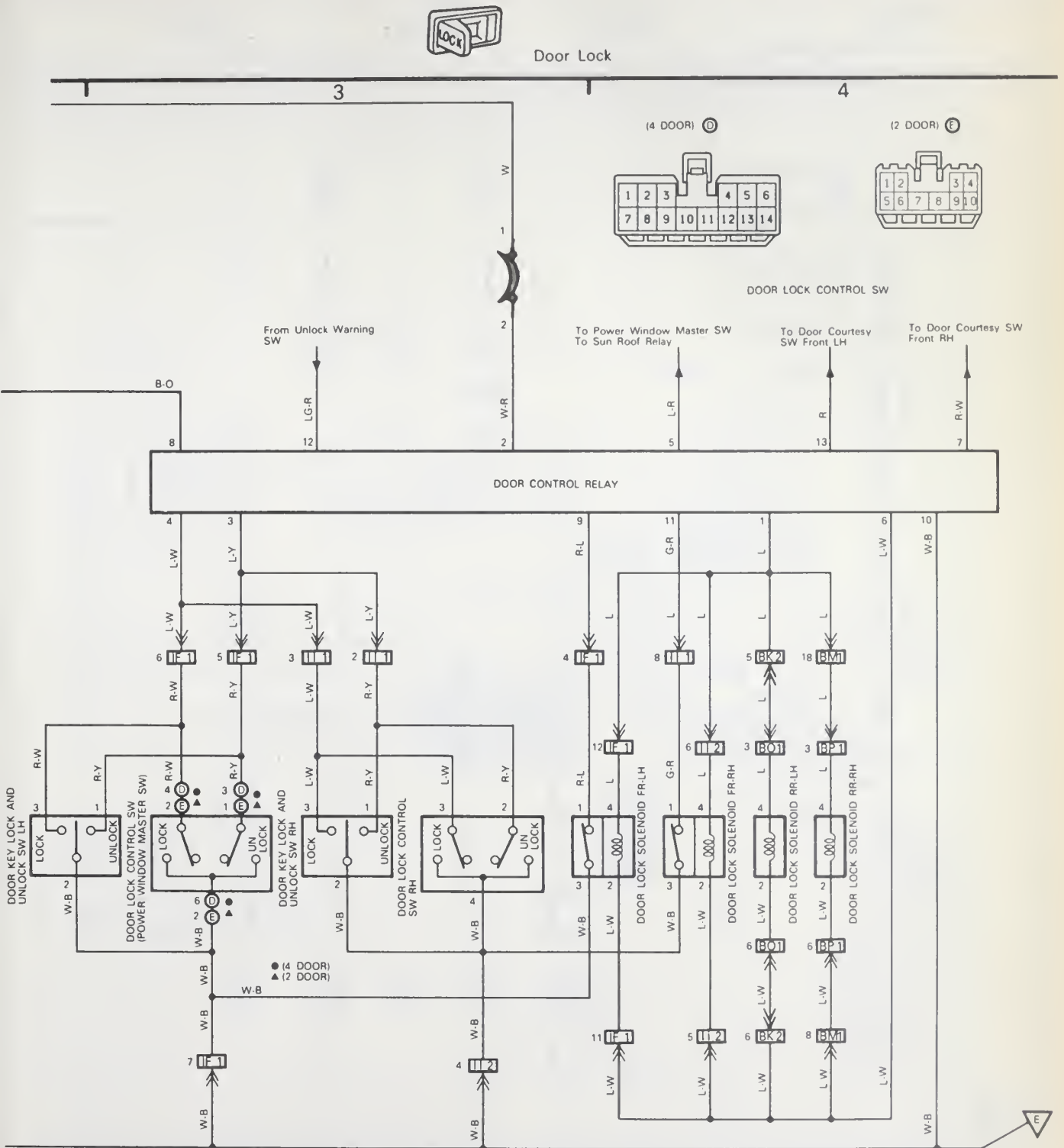
Wiring diagram – 1991 4Runner



Wiring diagram — 1991 4Runner

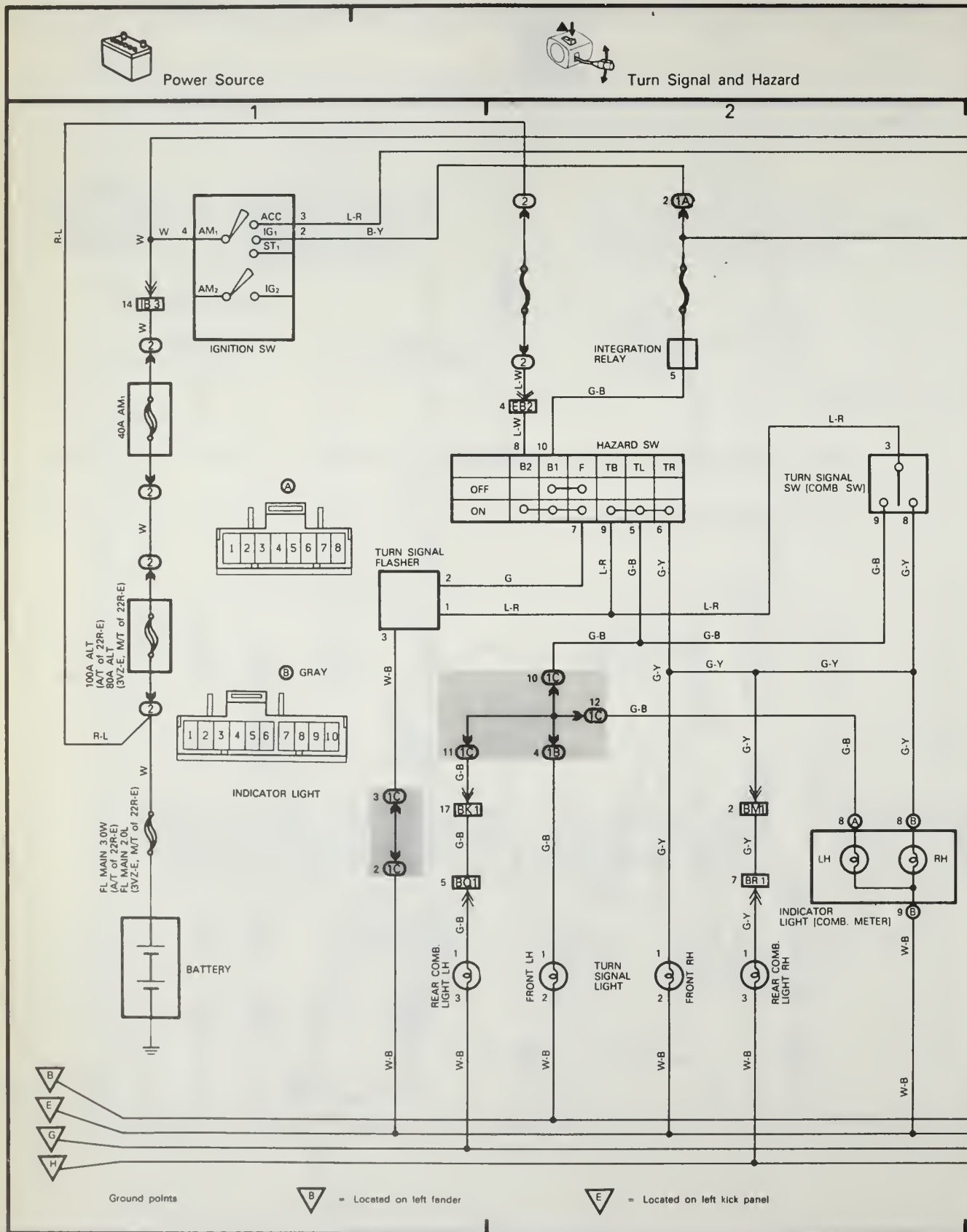
6





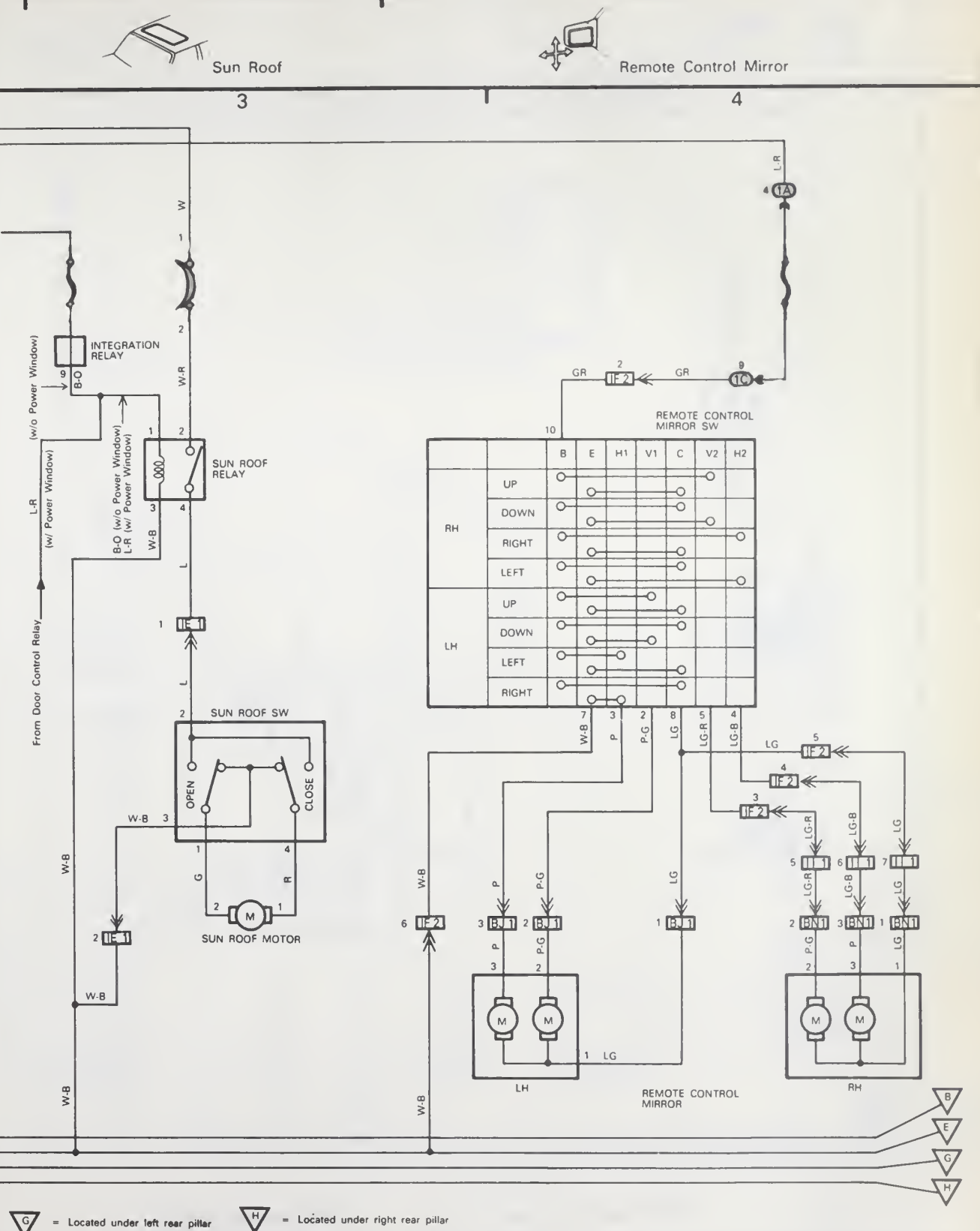
Wiring diagram — 1991 4Runner

6 CHASSIS ELECTRICAL



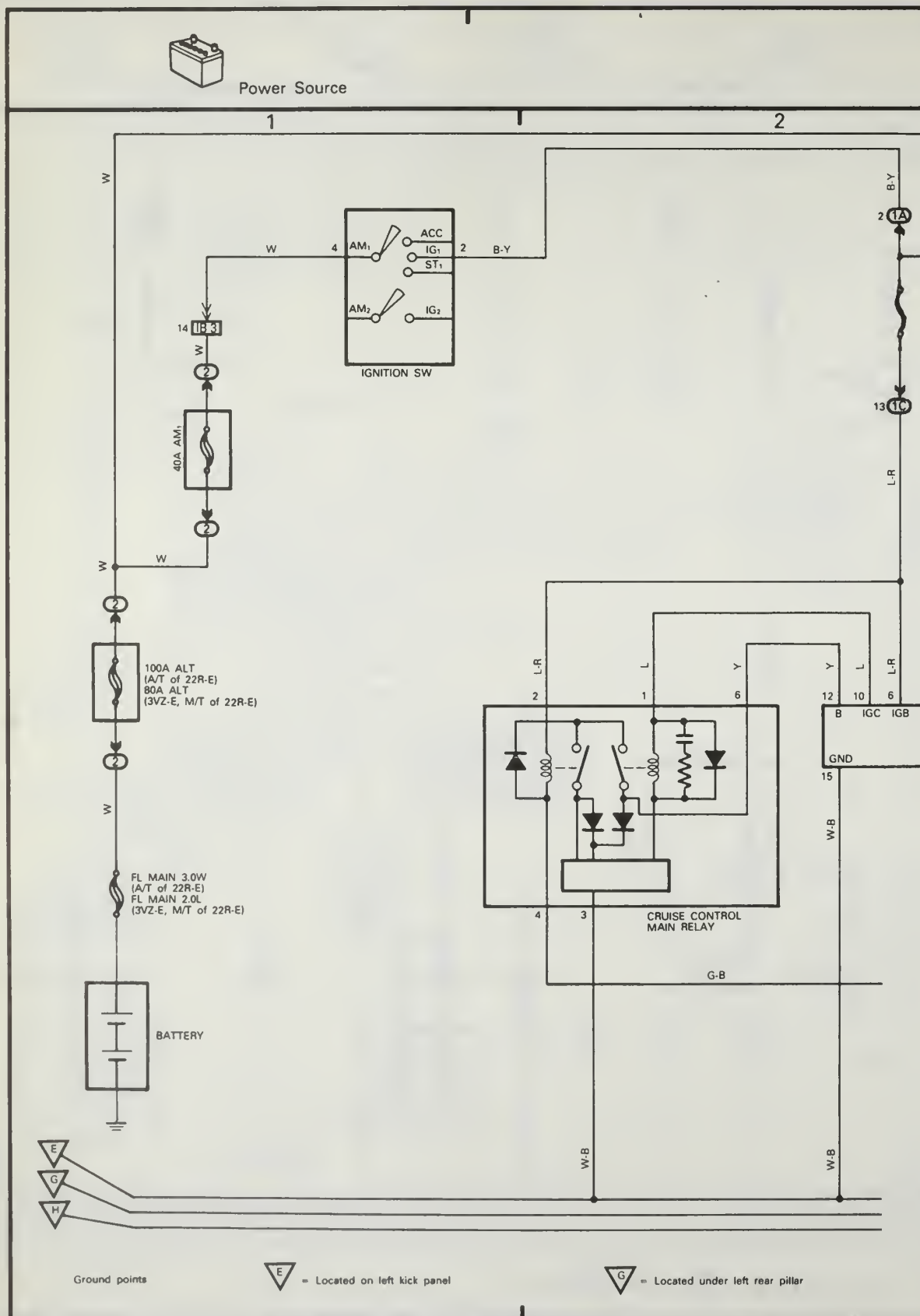
Wiring diagram — 1991 4Runner

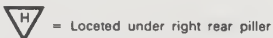
CHASSIS ELECTRICAL



Wiring diagram – 1991 4Runner

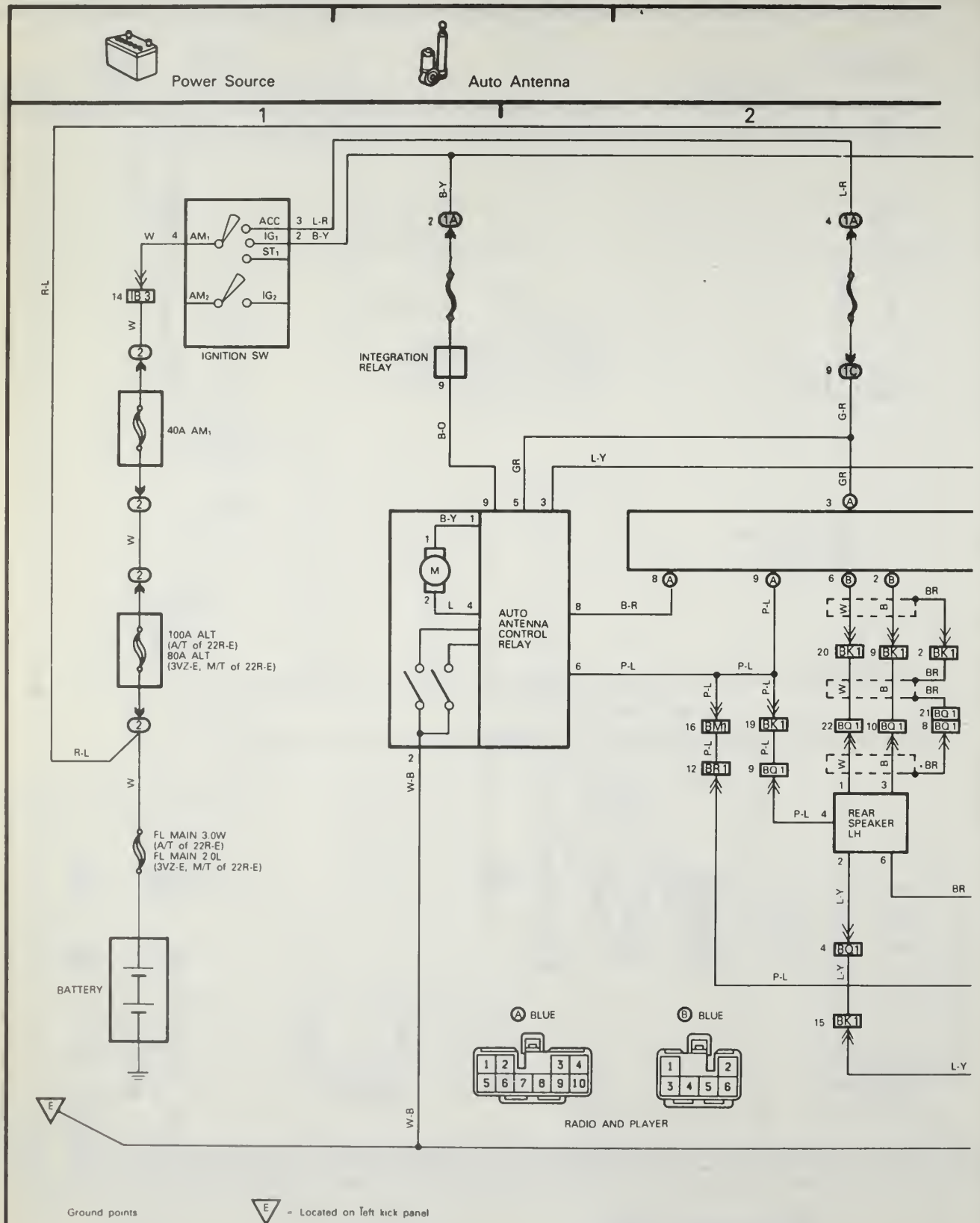
6 CHASSIS ELECTRICAL



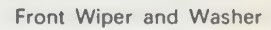


6-223

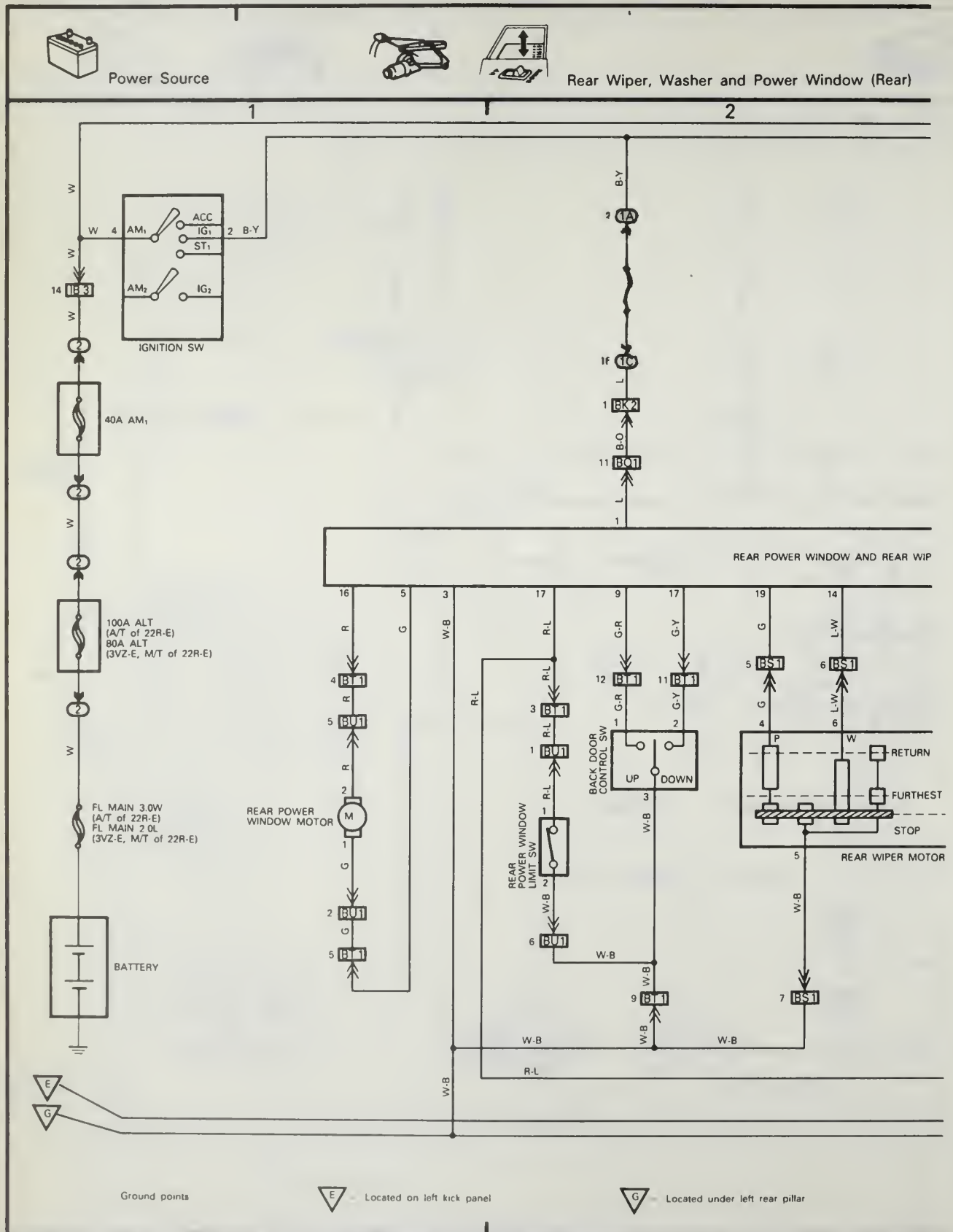
6 CHASSIS ELECTRICAL



Wiring diagram — 1991 4Runner



6 CHASSIS ELECTRICAL

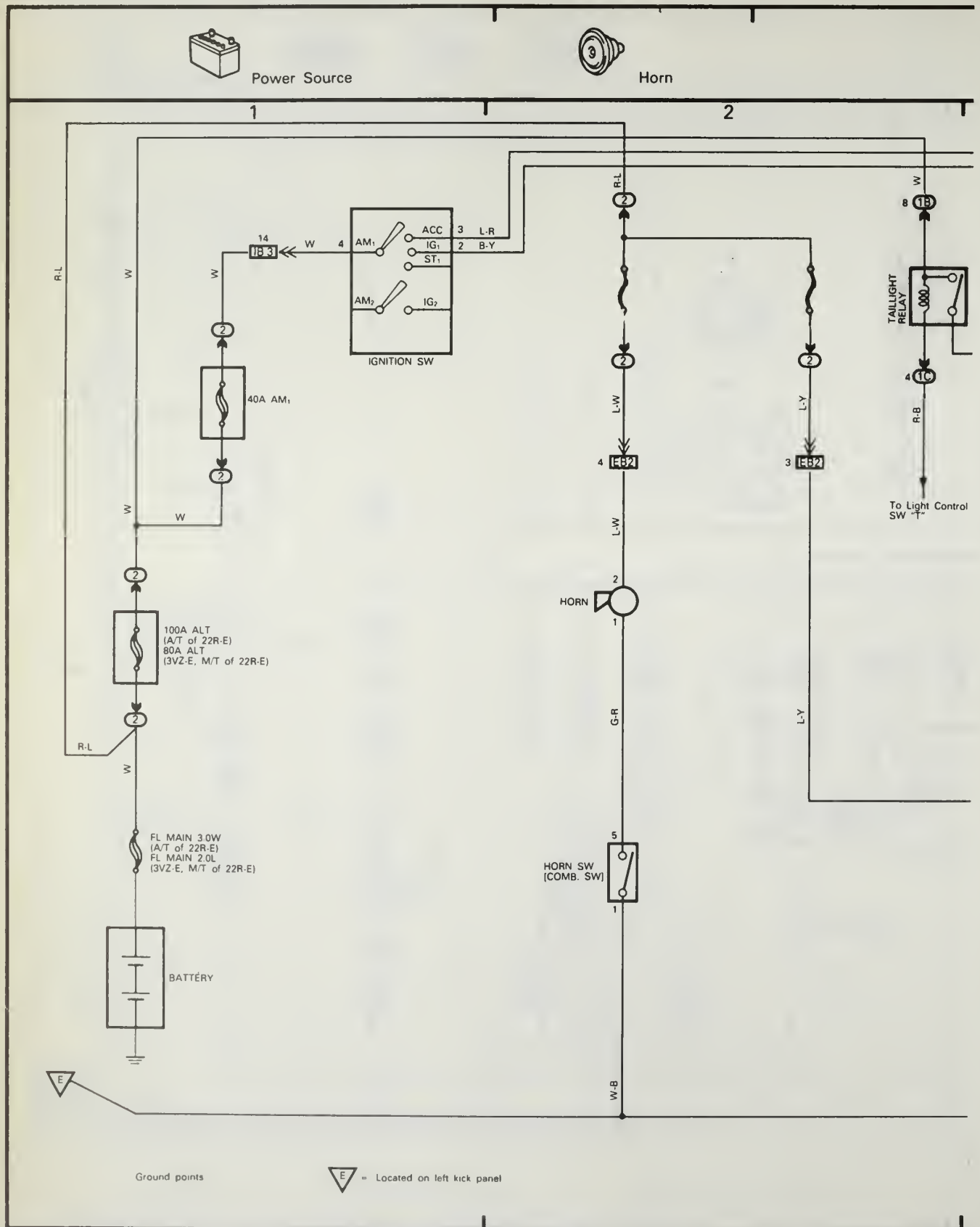


Wiring diagram — 1991 4Runner

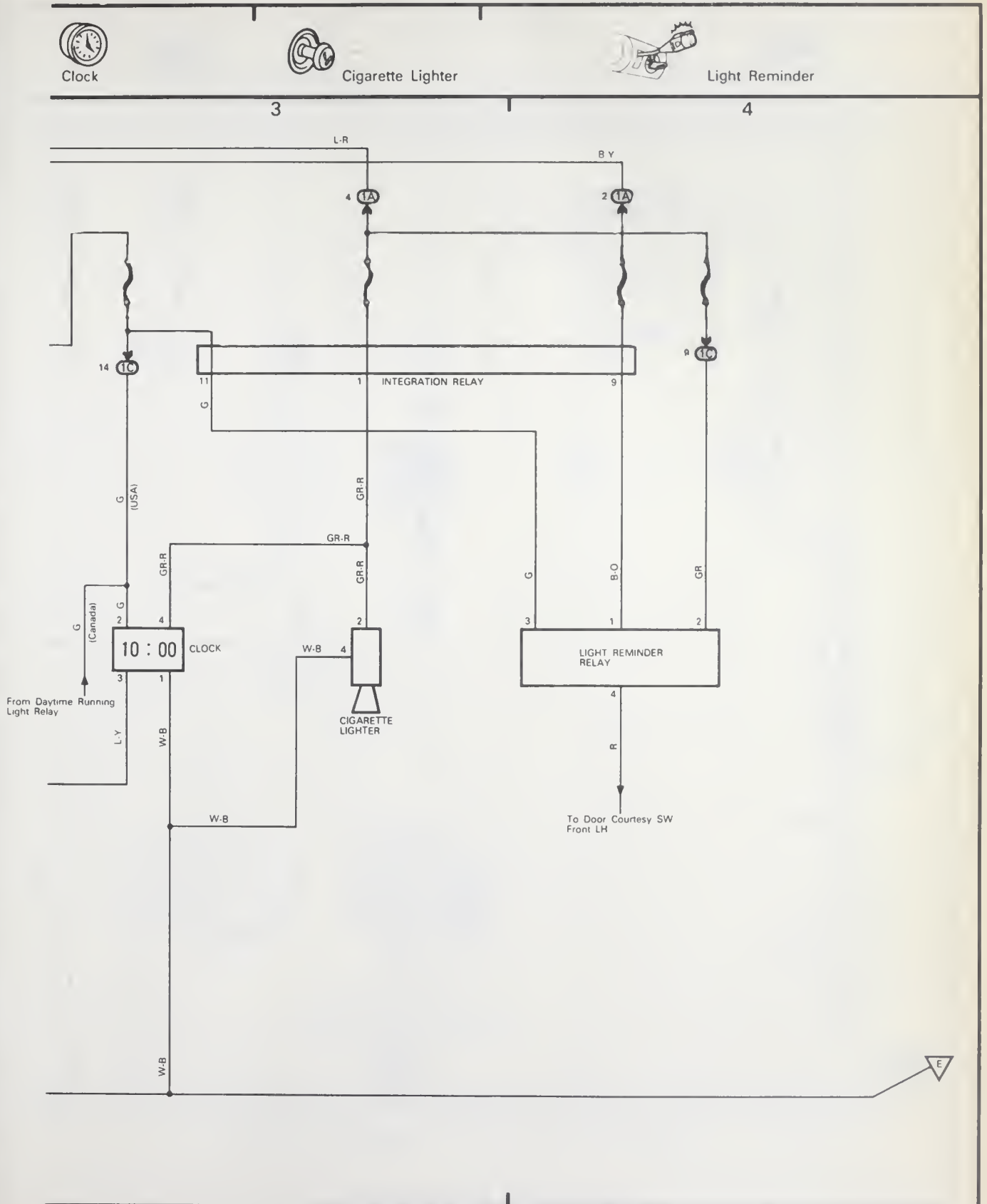


6-227

6 CHASSIS ELECTRICAL

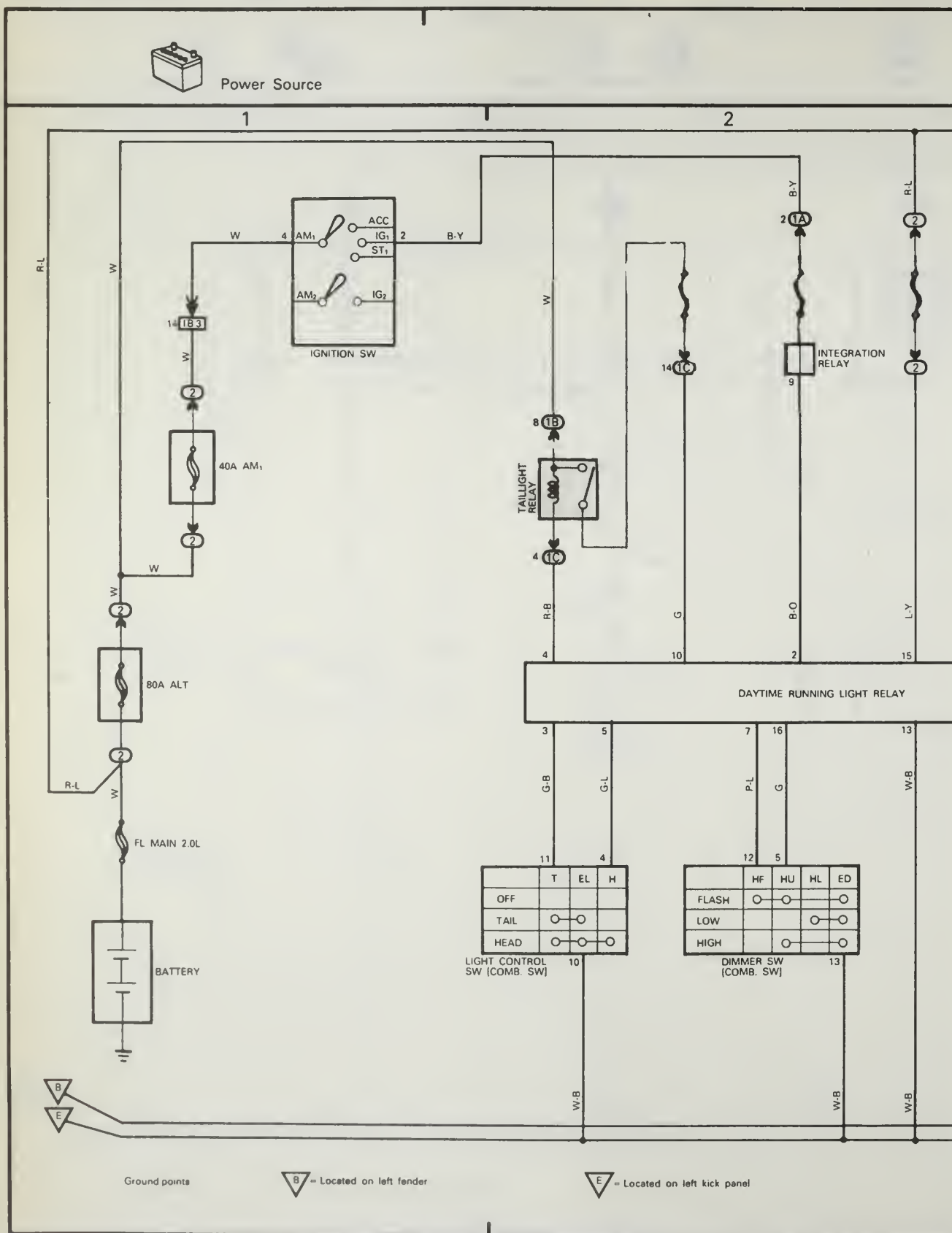


Wiring diagram — 1991 4Runner

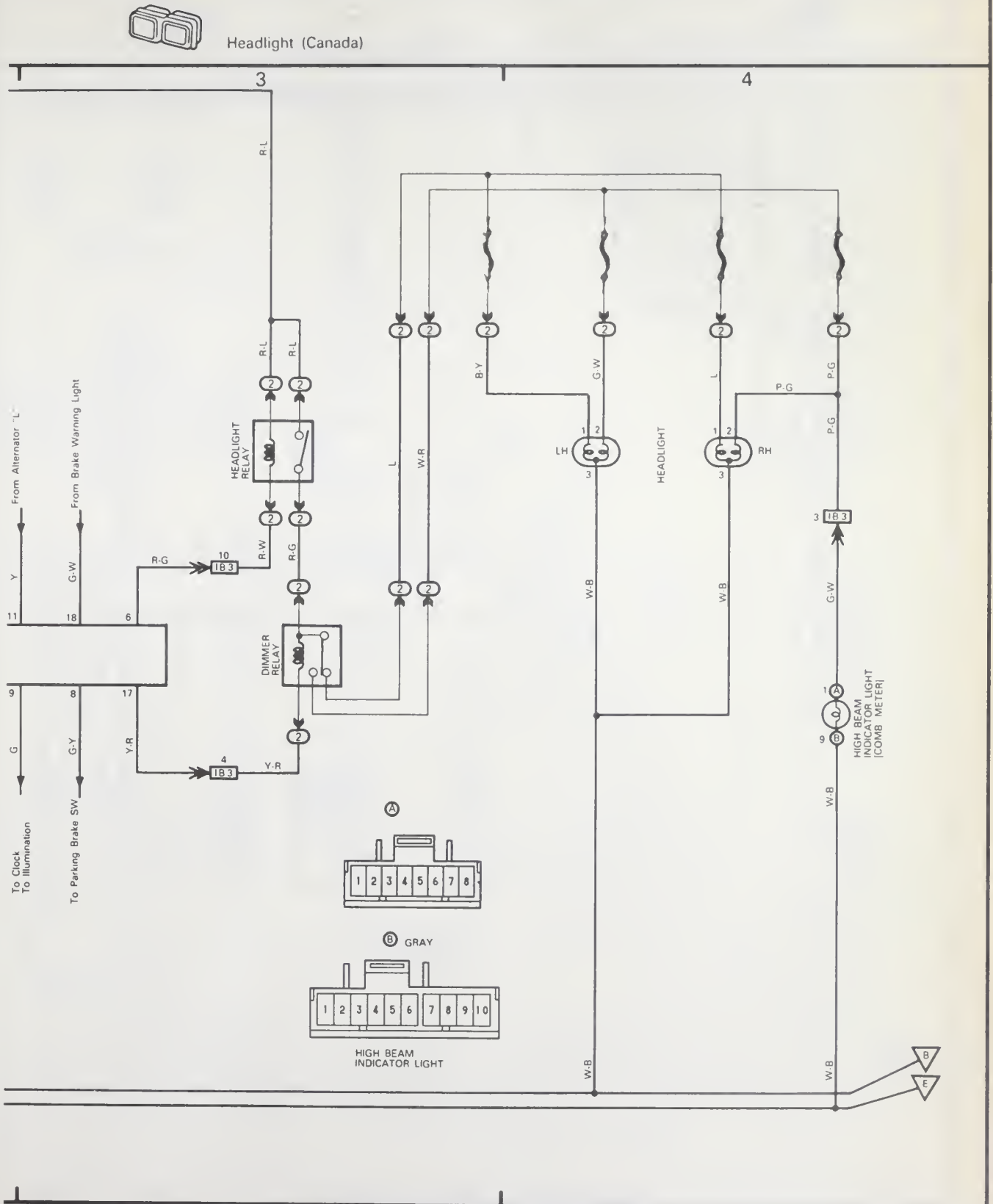


Wiring diagram — 1991 4Runner

6 CHASSIS ELECTRICAL

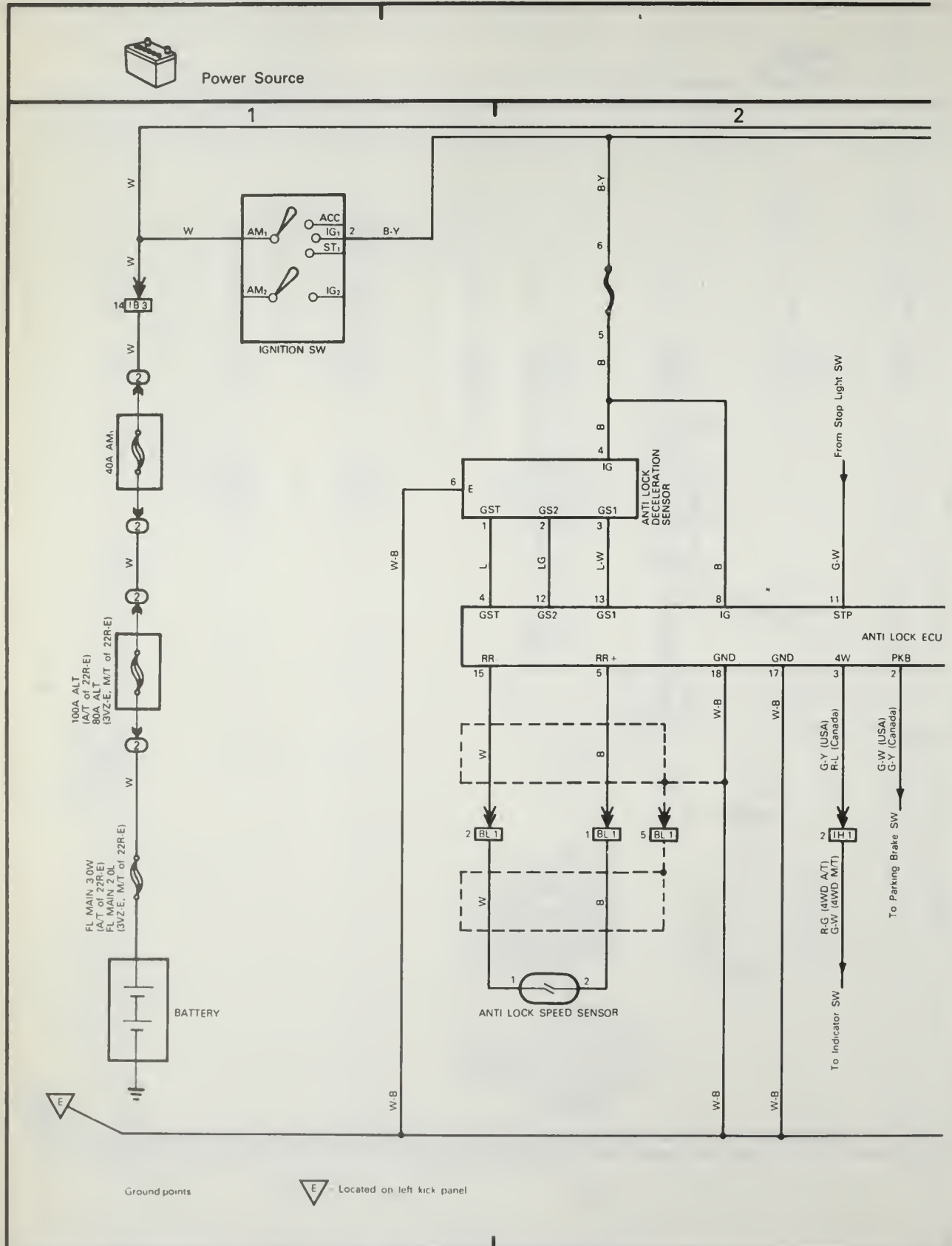


Wiring diagram — 1991 4Runner



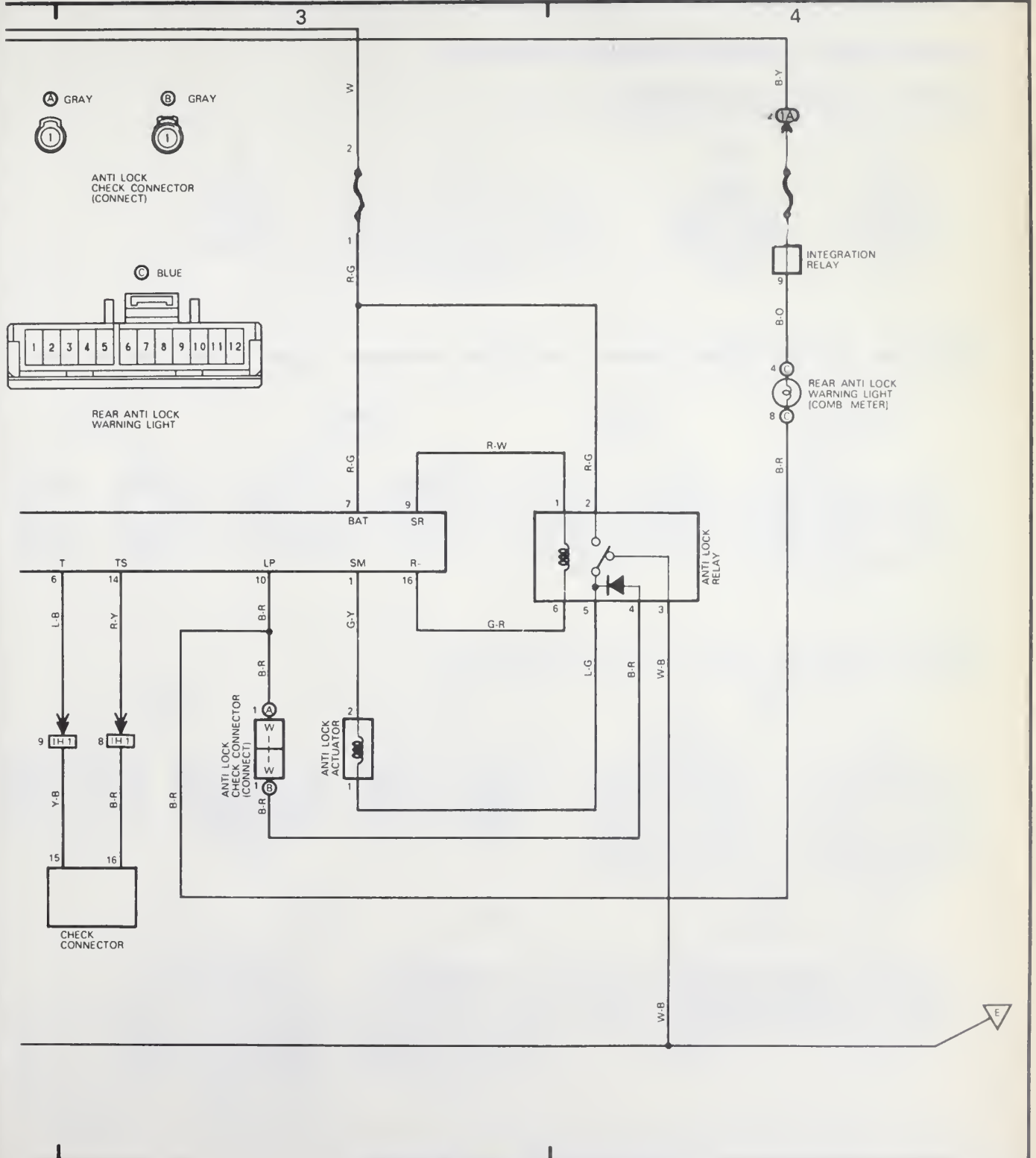
Wiring diagram — 1991 4Runner

6 CHASSIS ELECTRICAL





Rear Wheel Anti Lock Brake



Wiring diagram — 1991 4Runner

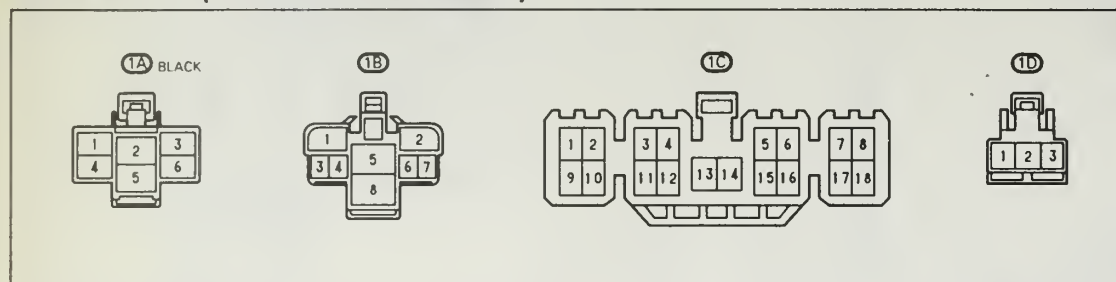
6 CHASSIS ELECTRICAL

1

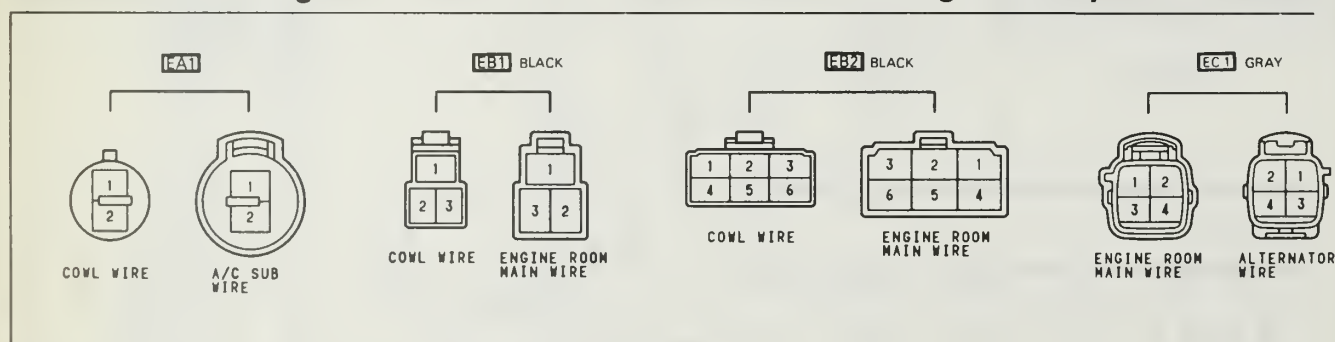
2

Junction Block and Wire Harness Connector

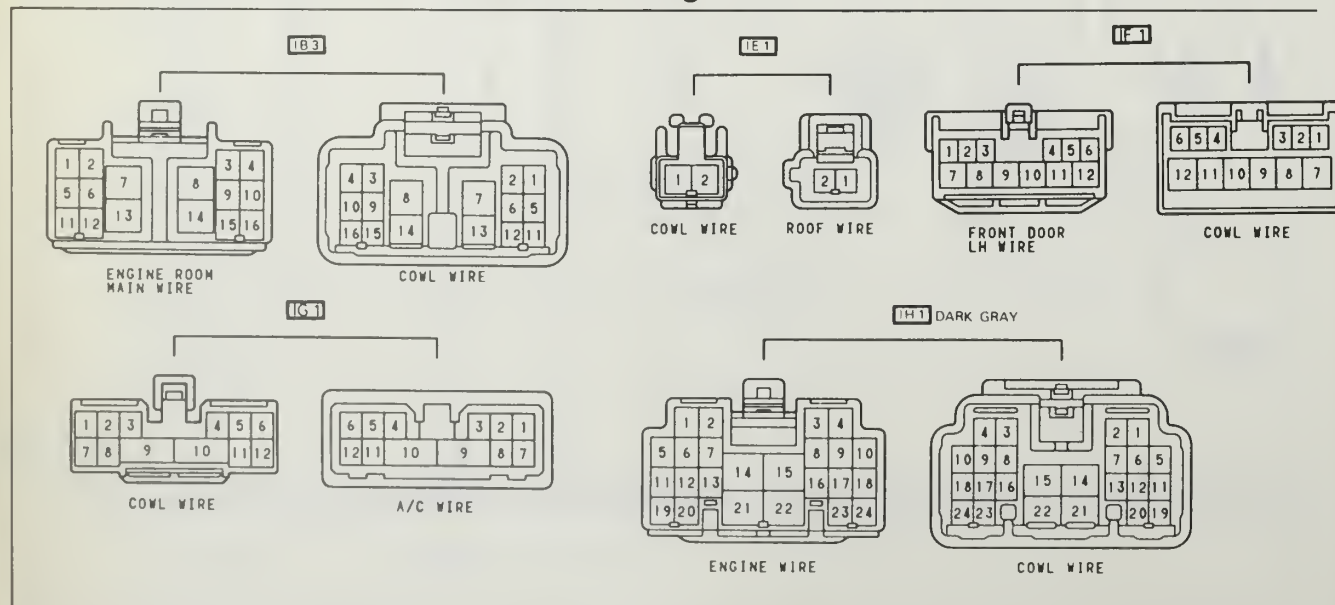
J/B NO. 1 (LEFT KICK PANEL)



Connector Joining Wire Harness and Wire Harness Engine Compartment area



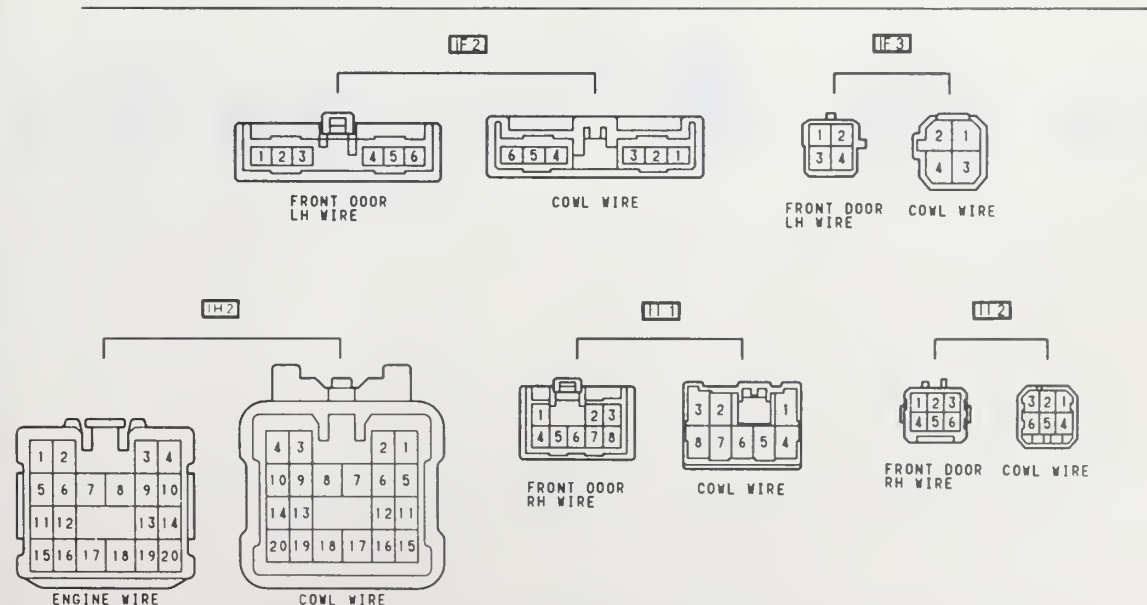
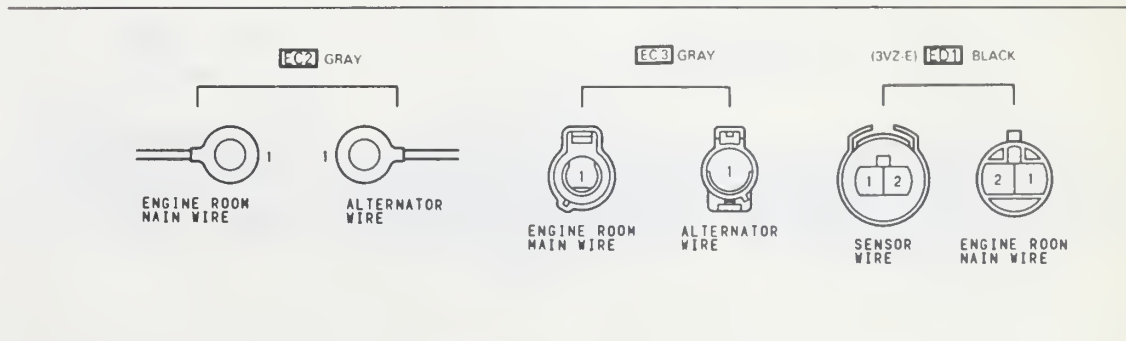
I Group: Instrument Panel and Surrounding area



Wiring diagram — 1991 4Runner

3

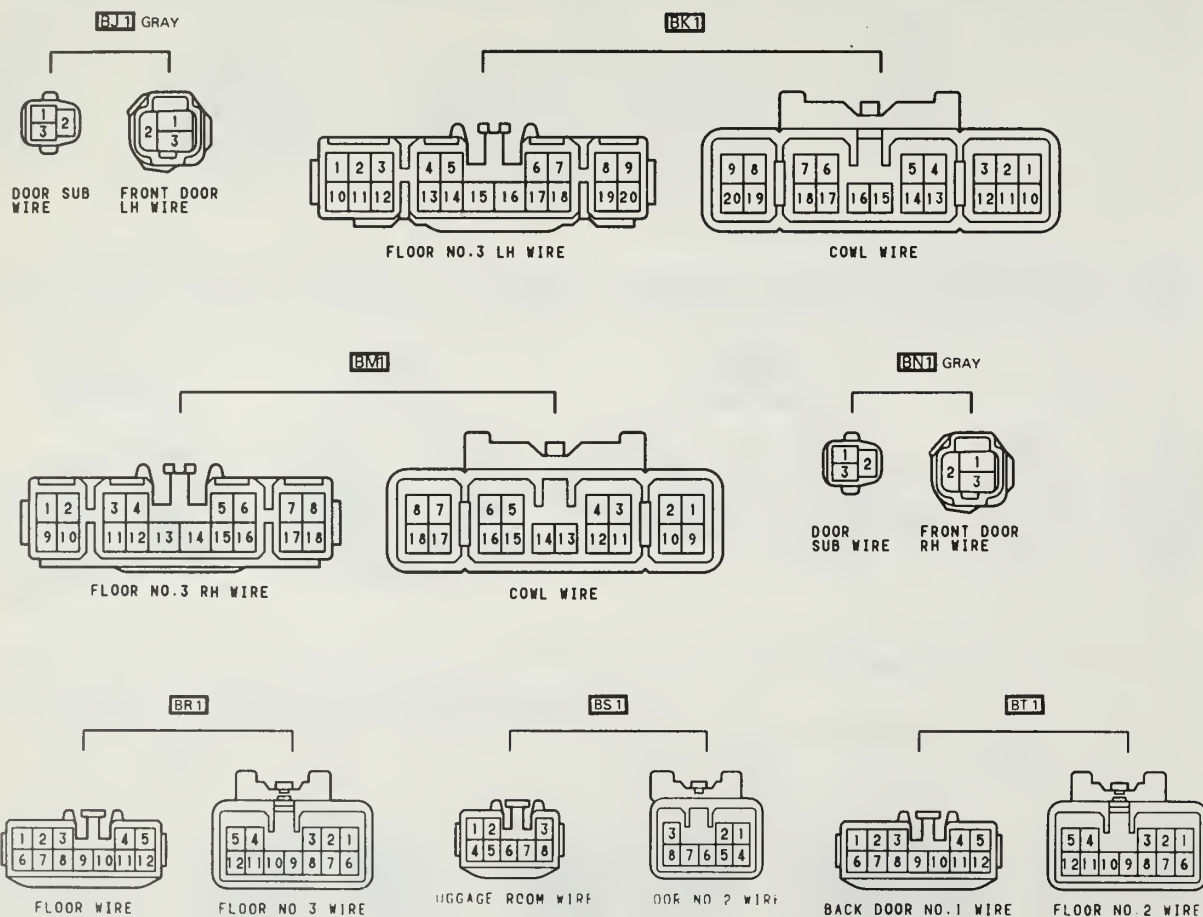
4



Wiring diagram — 1991 4Runner

6 CHASSIS ELECTRICAL

Connector Joining Wire Harness and Wire Harness (B Group: Body and Surrounding area)



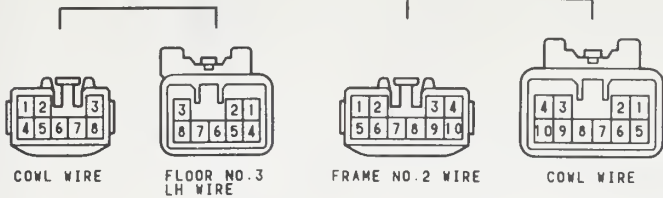
Wiring diagram — 1991 4Runner

3

4

BK2

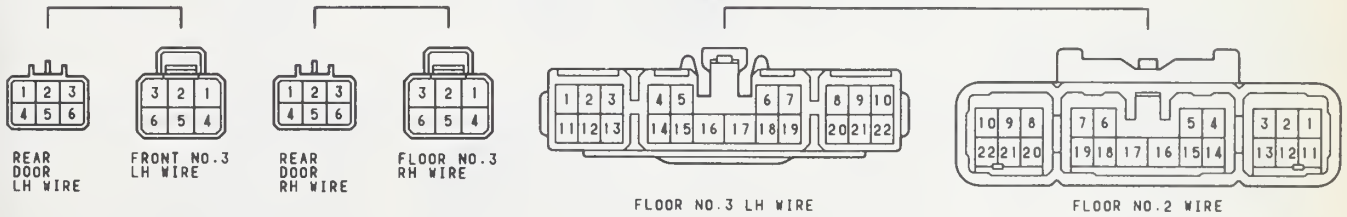
BL1 DARK GRAY



BQ1

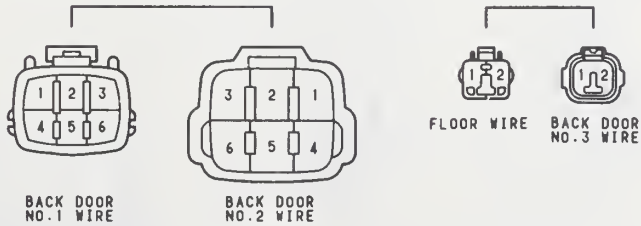
BP1

BQ1

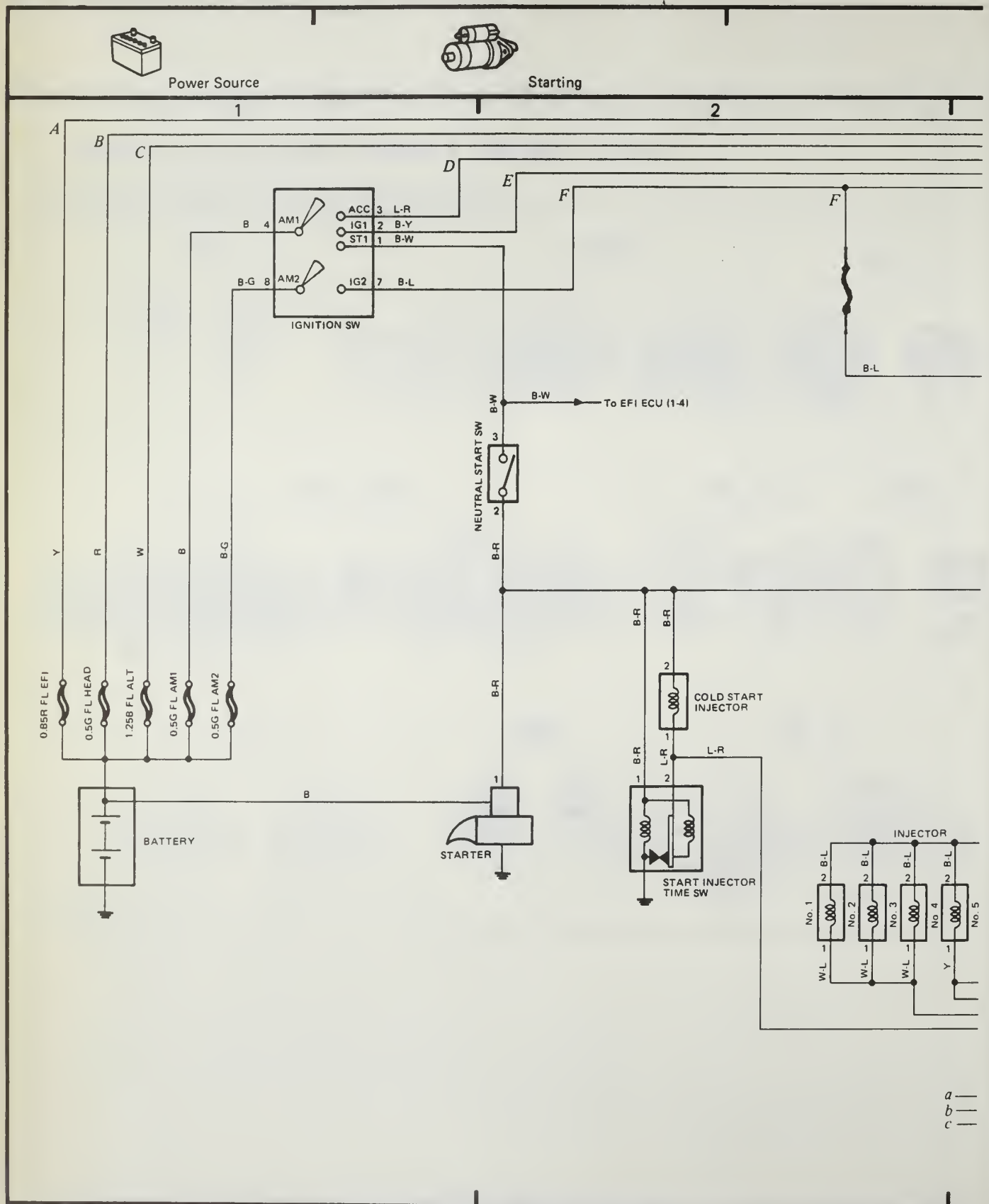


BV1

BV1



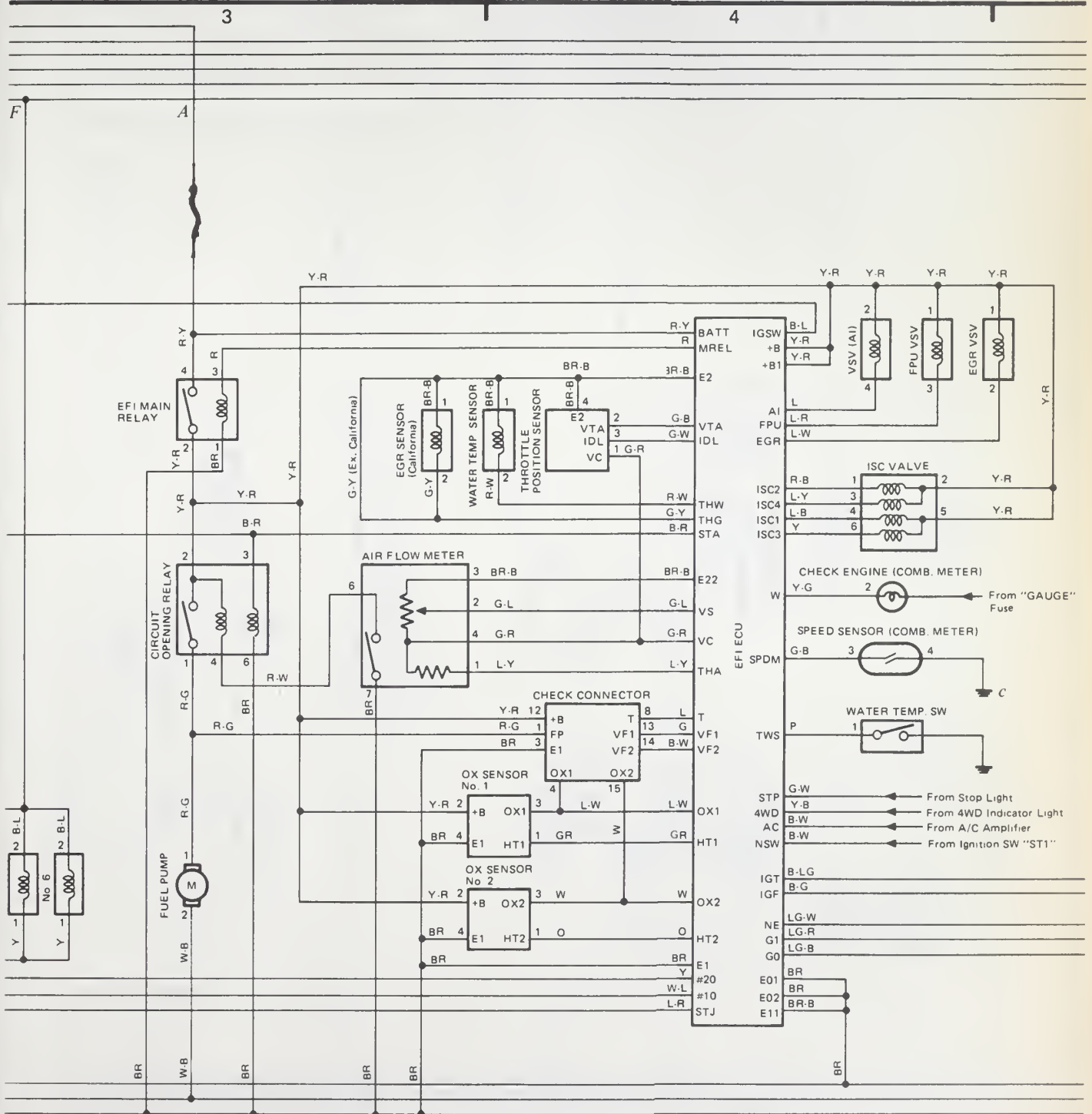
6 CHASSIS ELECTRICAL



Wiring diagram — 1989 Land Cruiser



EFI



Ground points

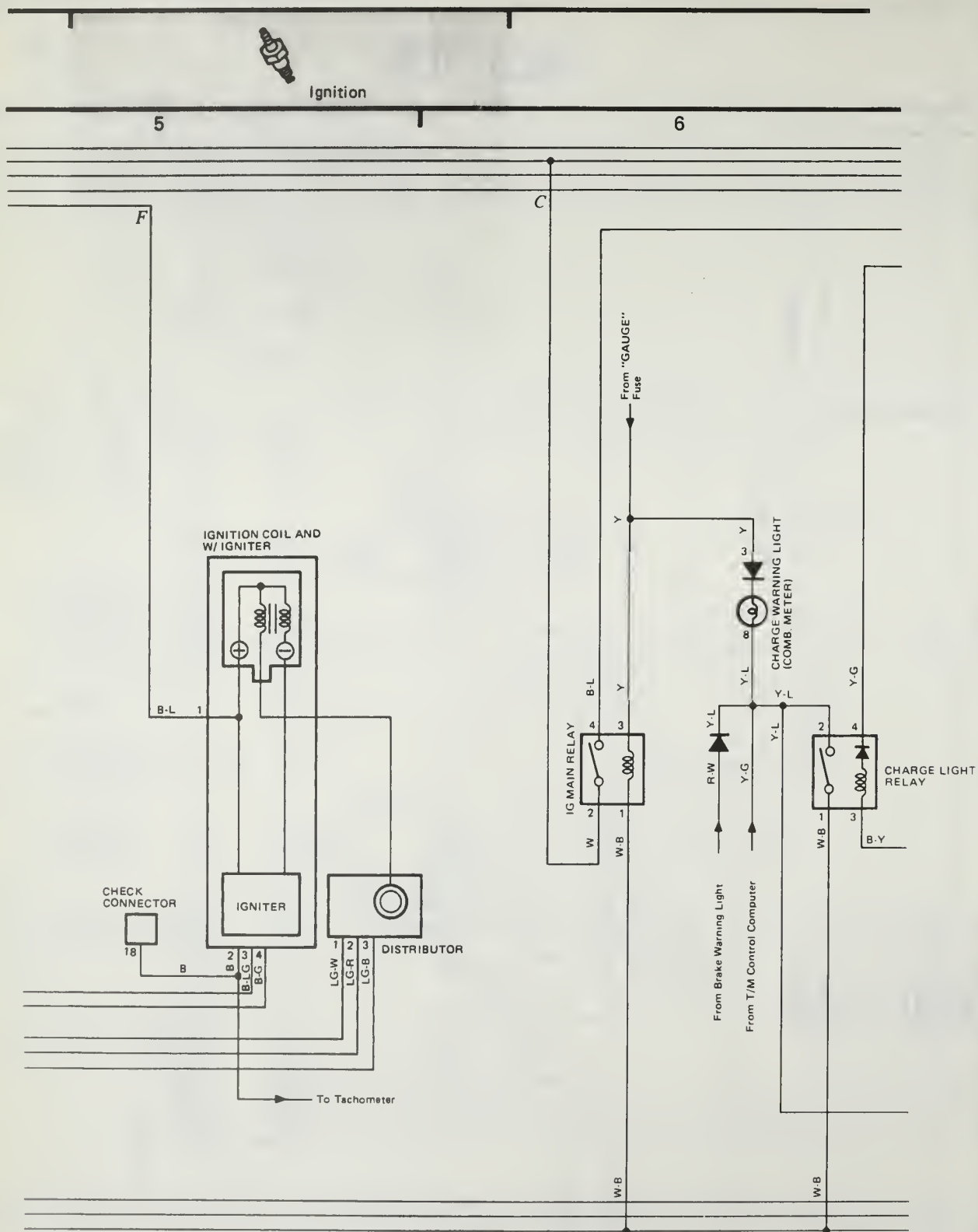
a = Located on engine block

b = Located on left front pillar

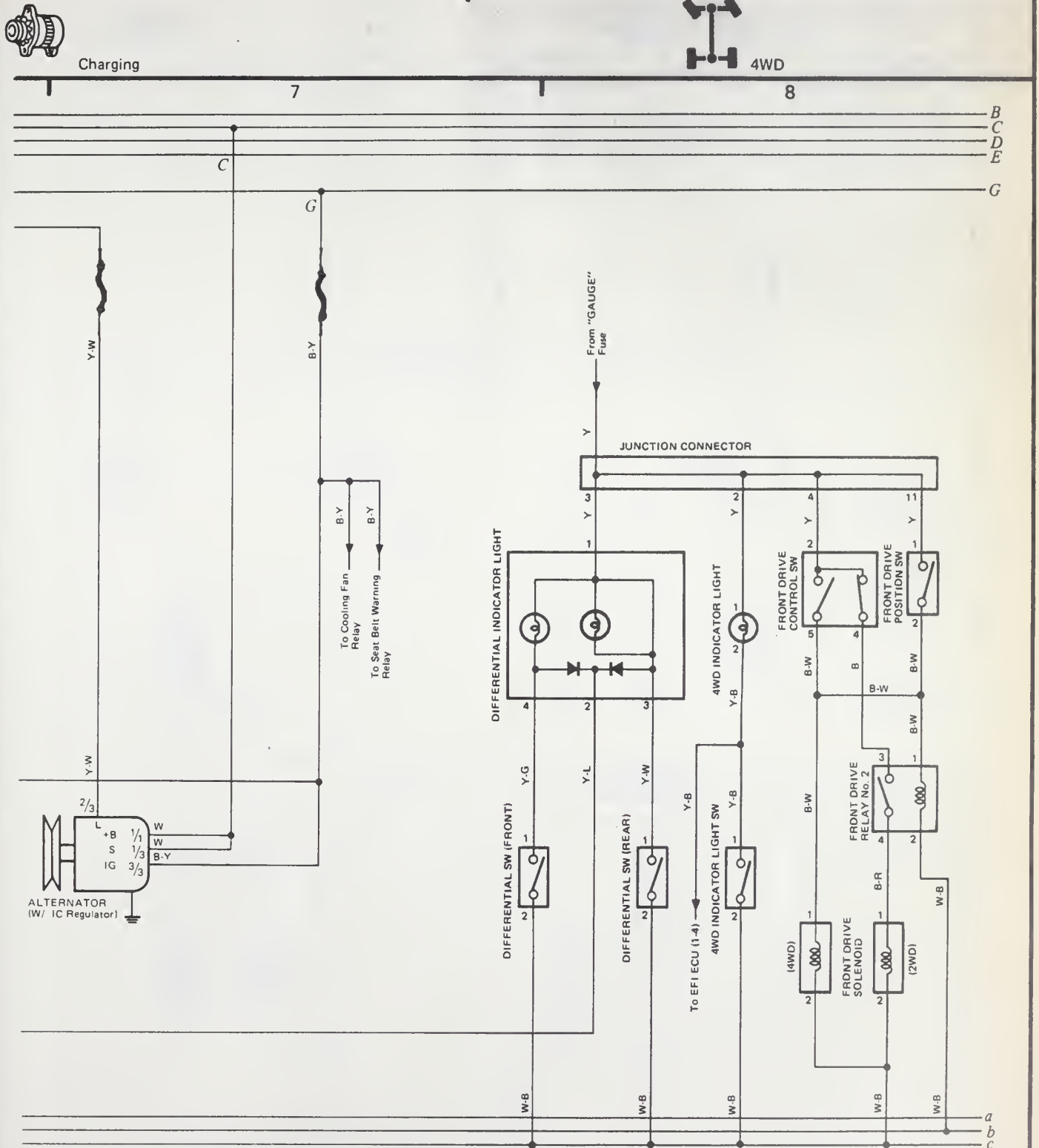
c = Located right front

Wiring diagram — 1989 Land Cruiser

6 CHASSIS ELECTRICAL



Wiring diagram — 1989 Land Cruiser

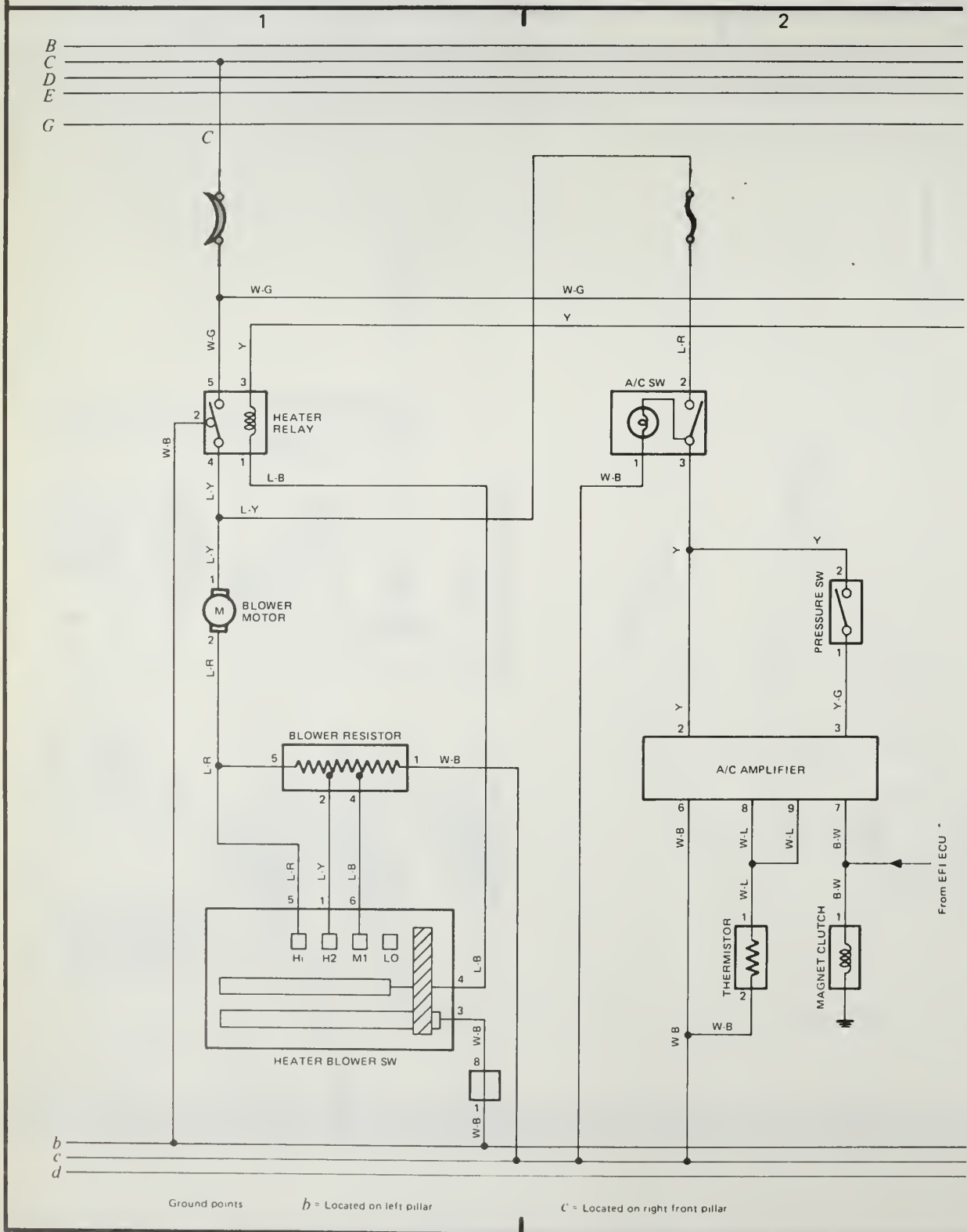


Wiring diagram — 1989 Land Cruiser

6 CHASSIS ELECTRICAL



Air Conditioner, Cooler and Heater



Wiring diagram — 1989 Land Cruiser



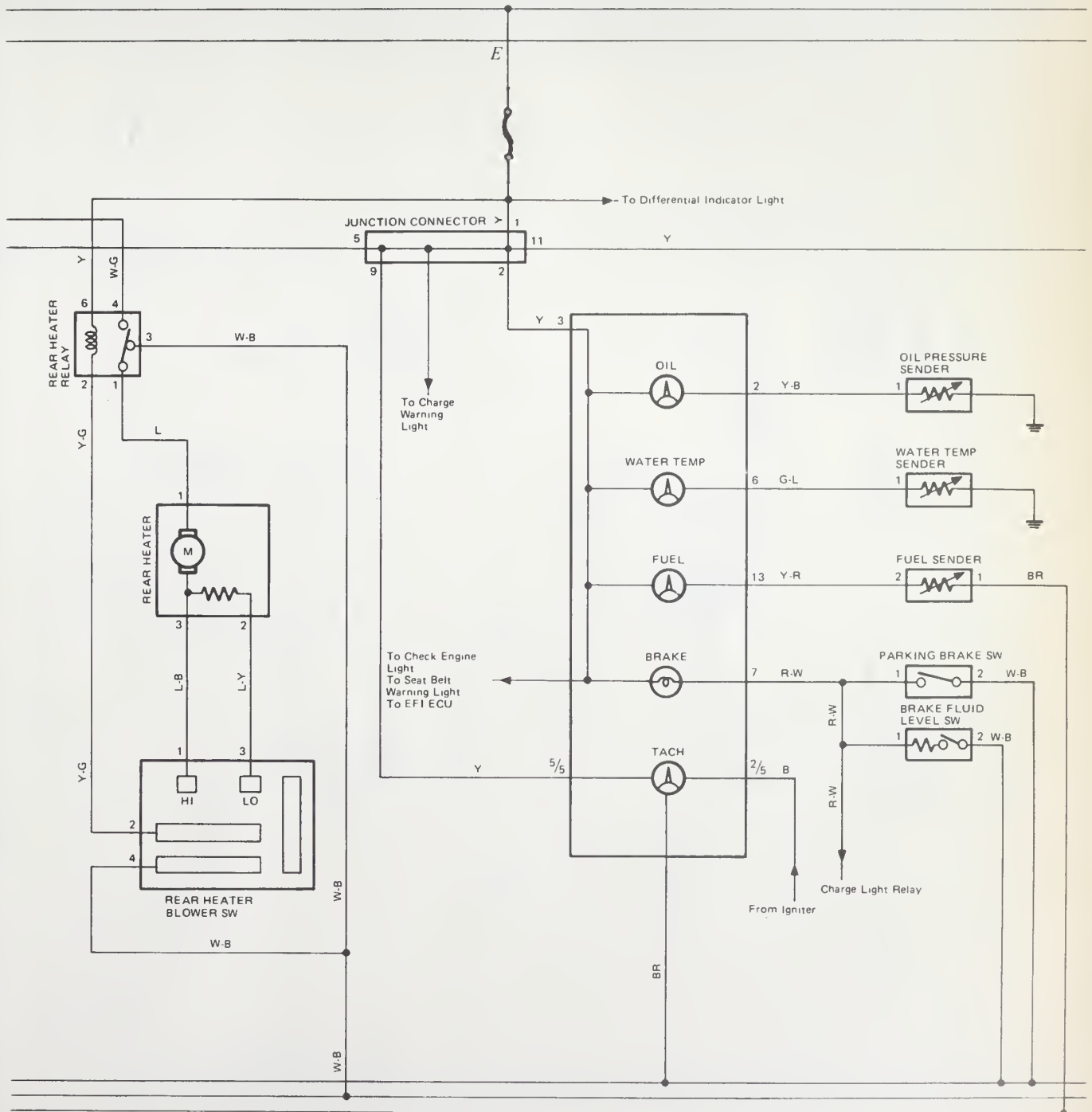
Rear Air Conditioner



Combination Meter

3

4



d = Located on center of back panel

Wiring diagram – 1989 Land Cruiser

6 CHASSIS ELECTRICAL



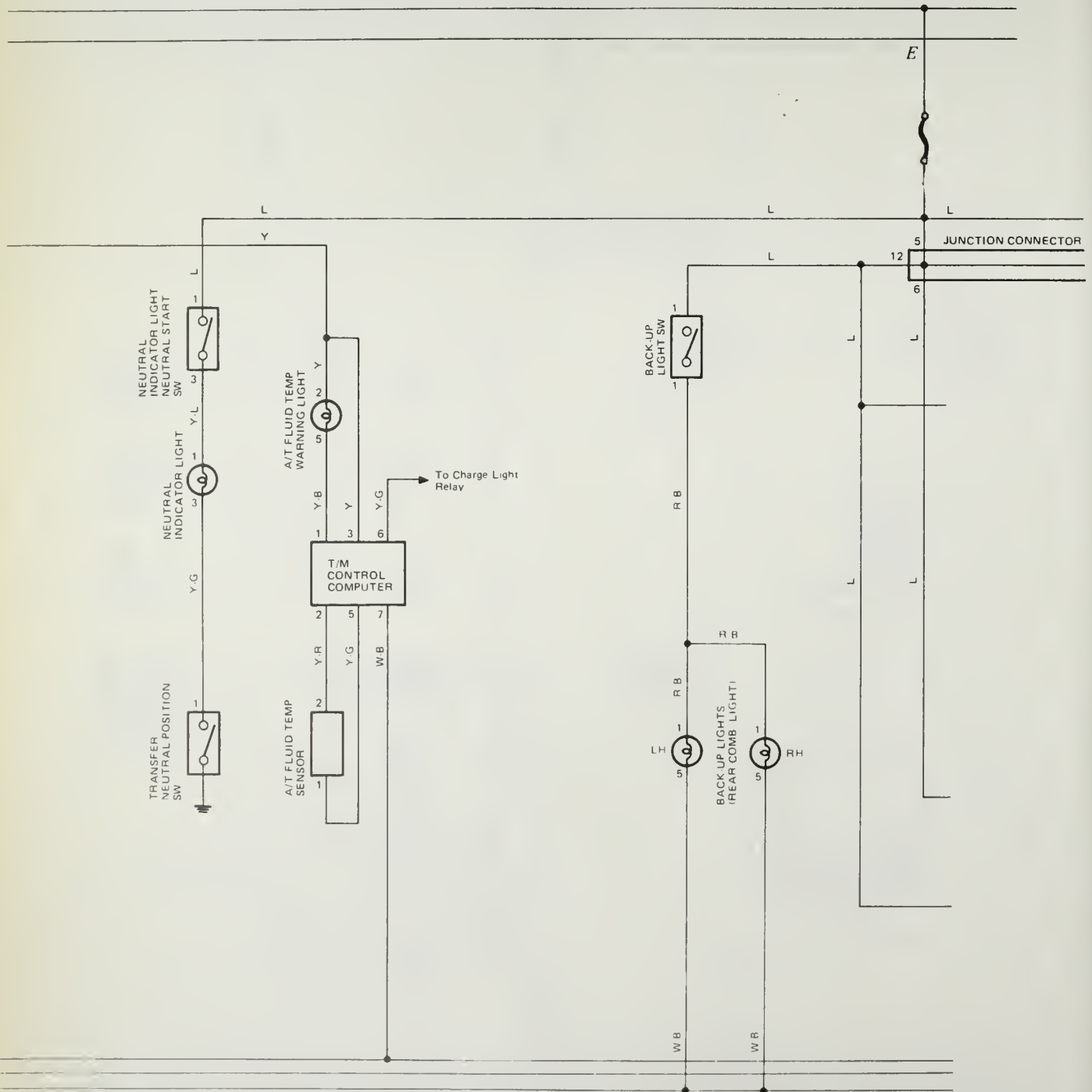
A/T Fluid Temp. Warning



Back-up Lights

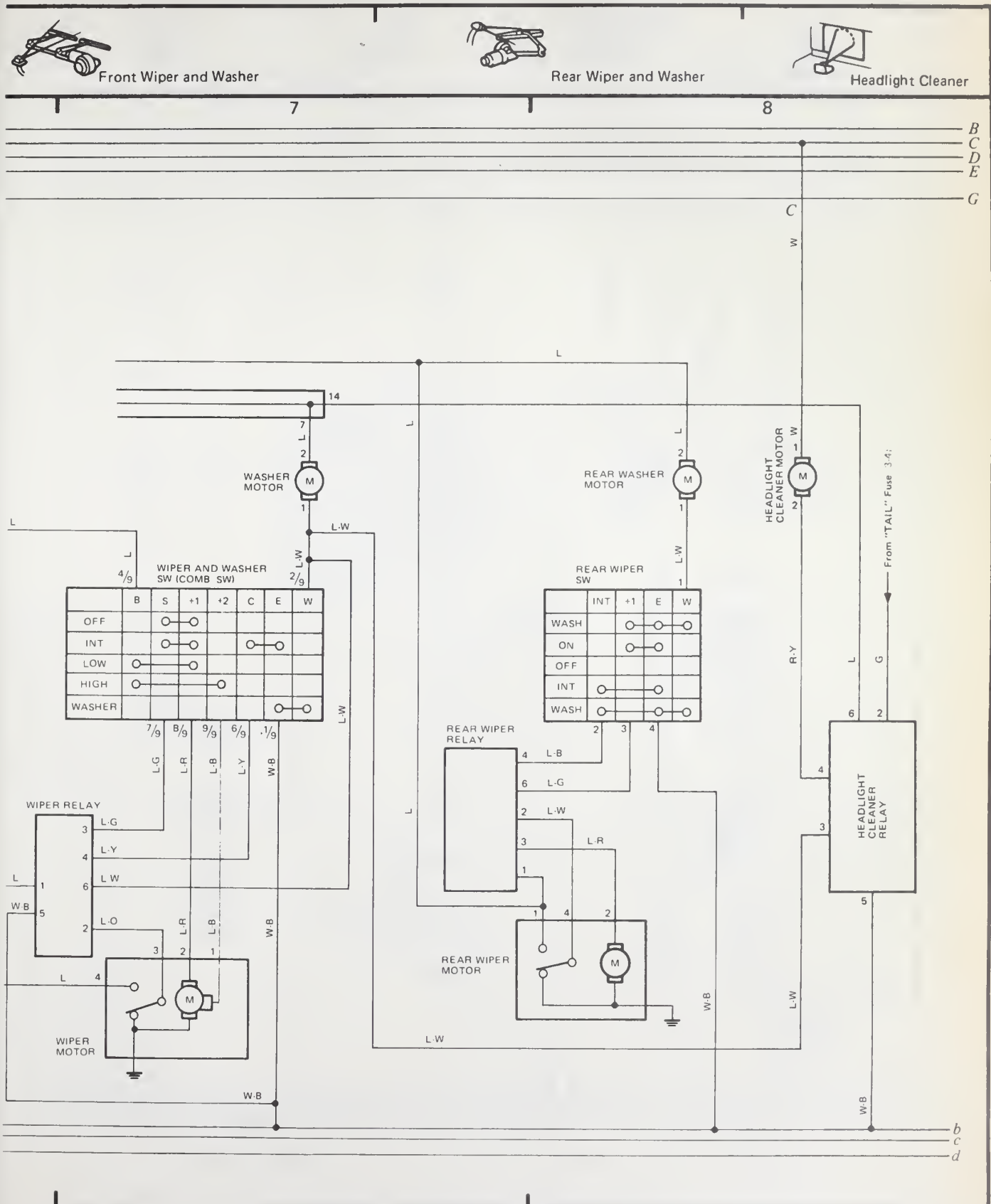
5

6



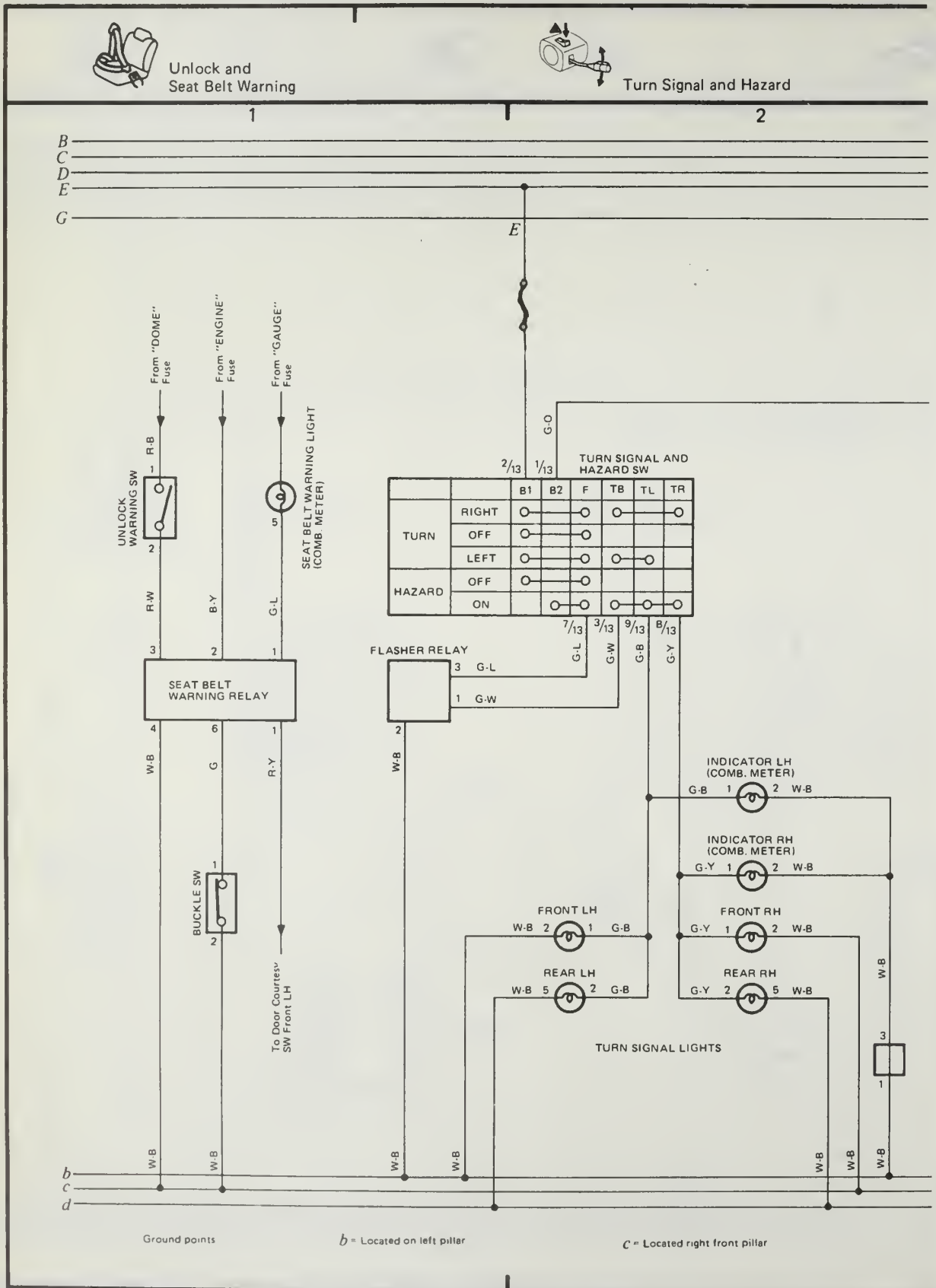
Wiring diagram — 1989 Land Cruiser

CHASSIS ELECTRICAL 6



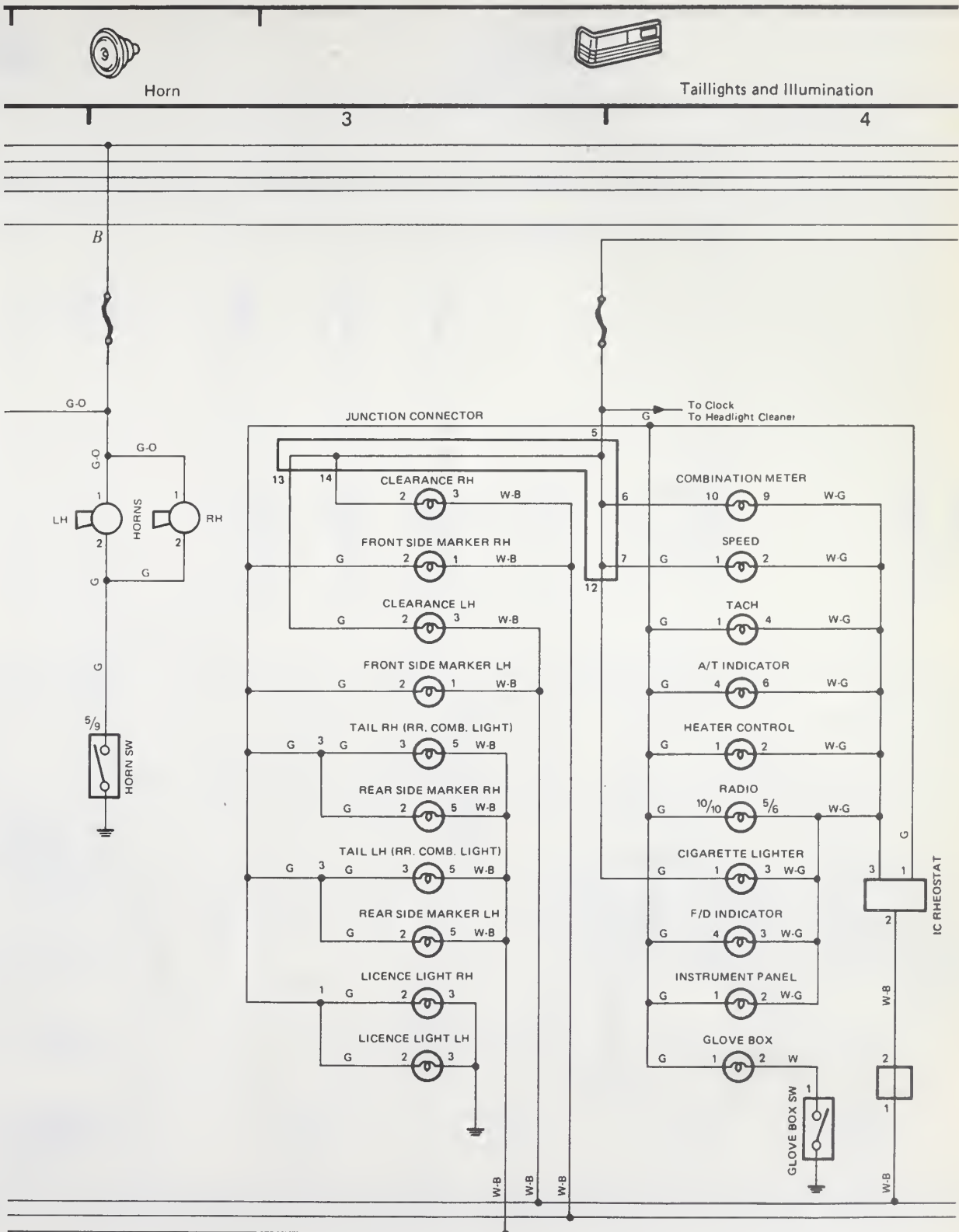
Wiring diagram — 1989 Land Cruiser

6 CHASSIS ELECTRICAL



Wiring diagram — 1989 Land Cruiser

CHASSIS ELECTRICAL 6



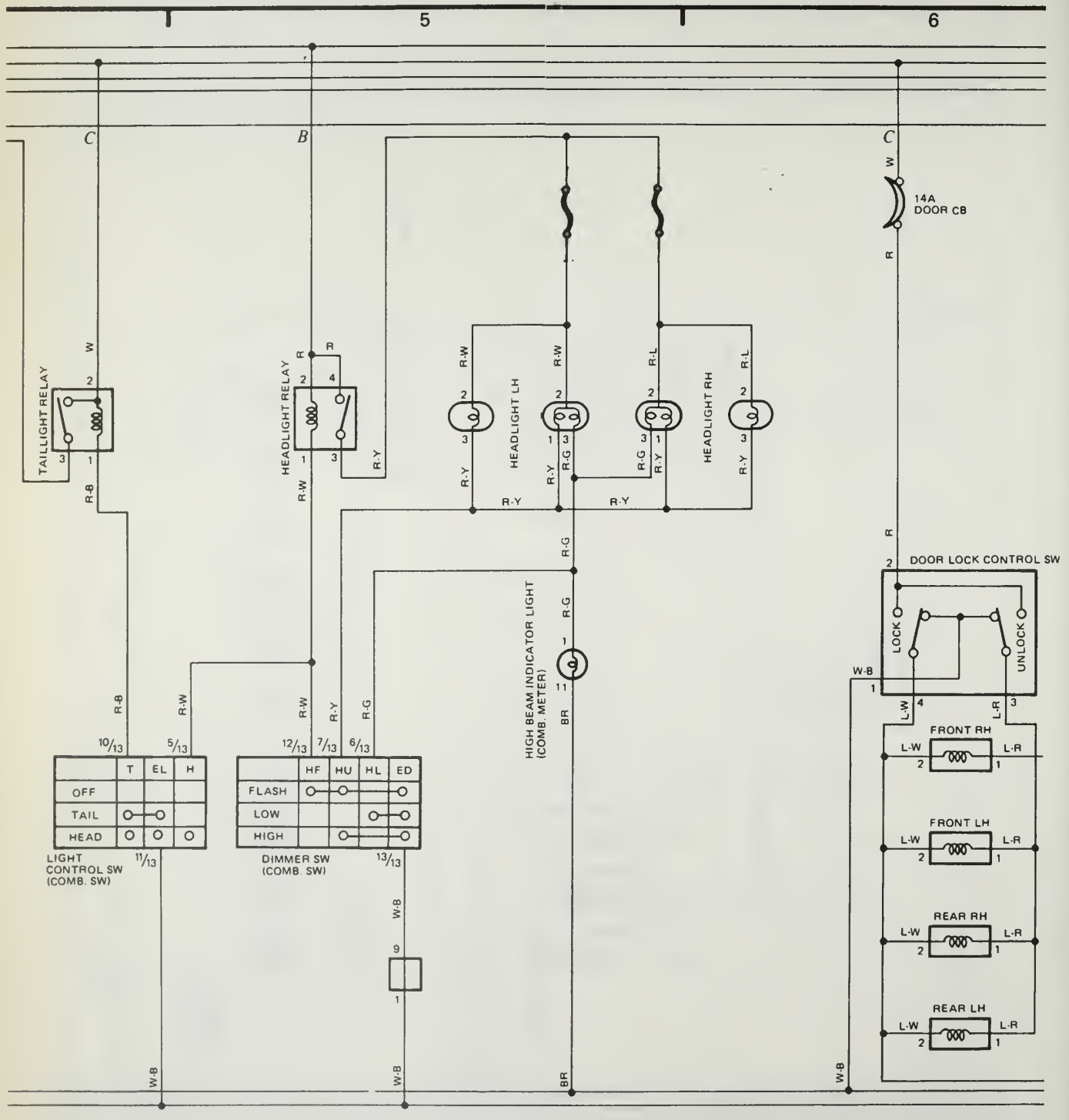
d = Located on center of back panel

Wiring diagram — 1989 Land Cruiser

6 CHASSIS ELECTRICAL

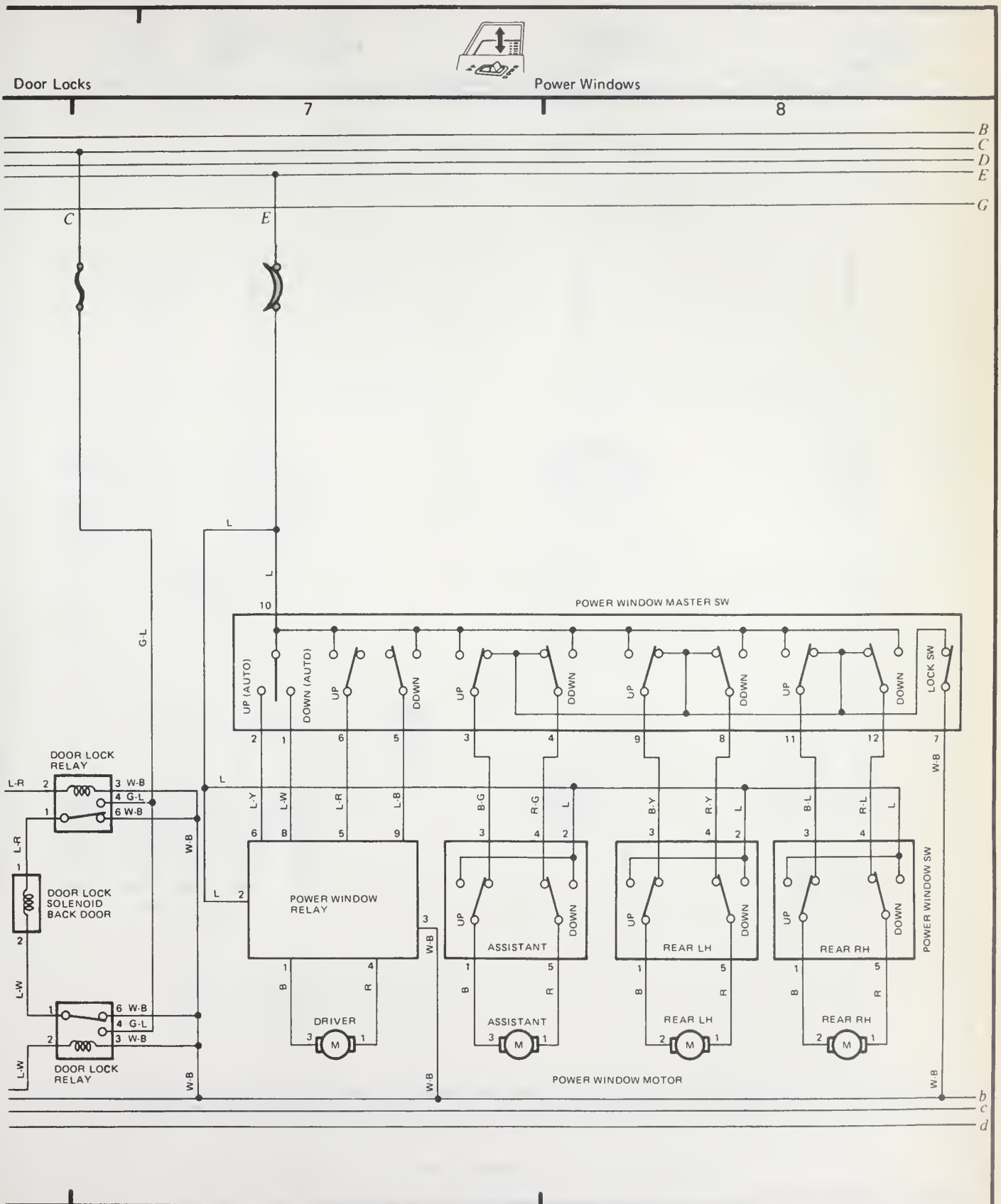


Headlight



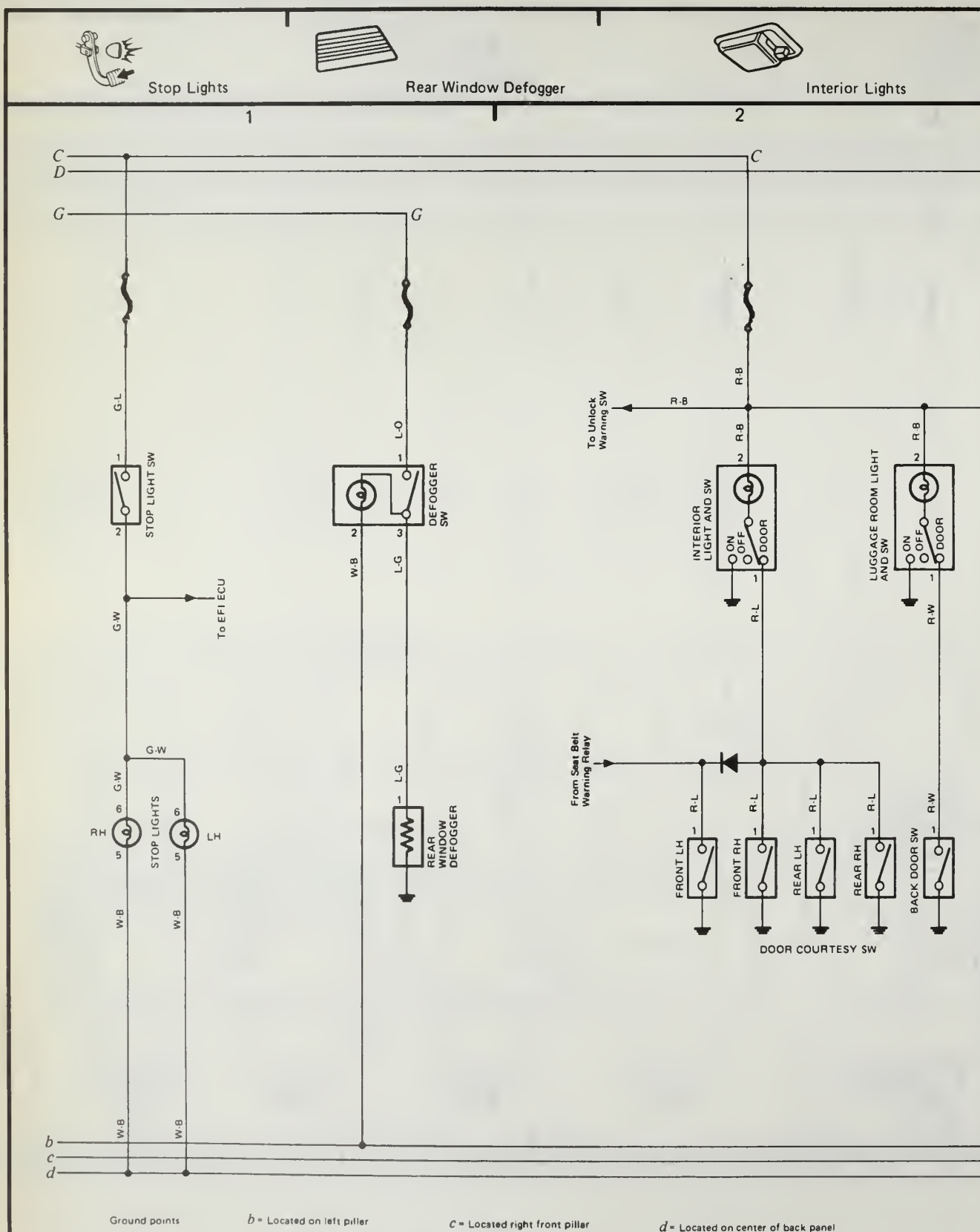
Wiring diagram — 1989 Land Cruiser

CHASSIS ELECTRICAL 6



Wiring diagram — 1989 Land Cruiser

6 CHASSIS ELECTRICAL



Wiring diagram — 1989 Land Cruiser

6 CHASSIS ELECTRICAL



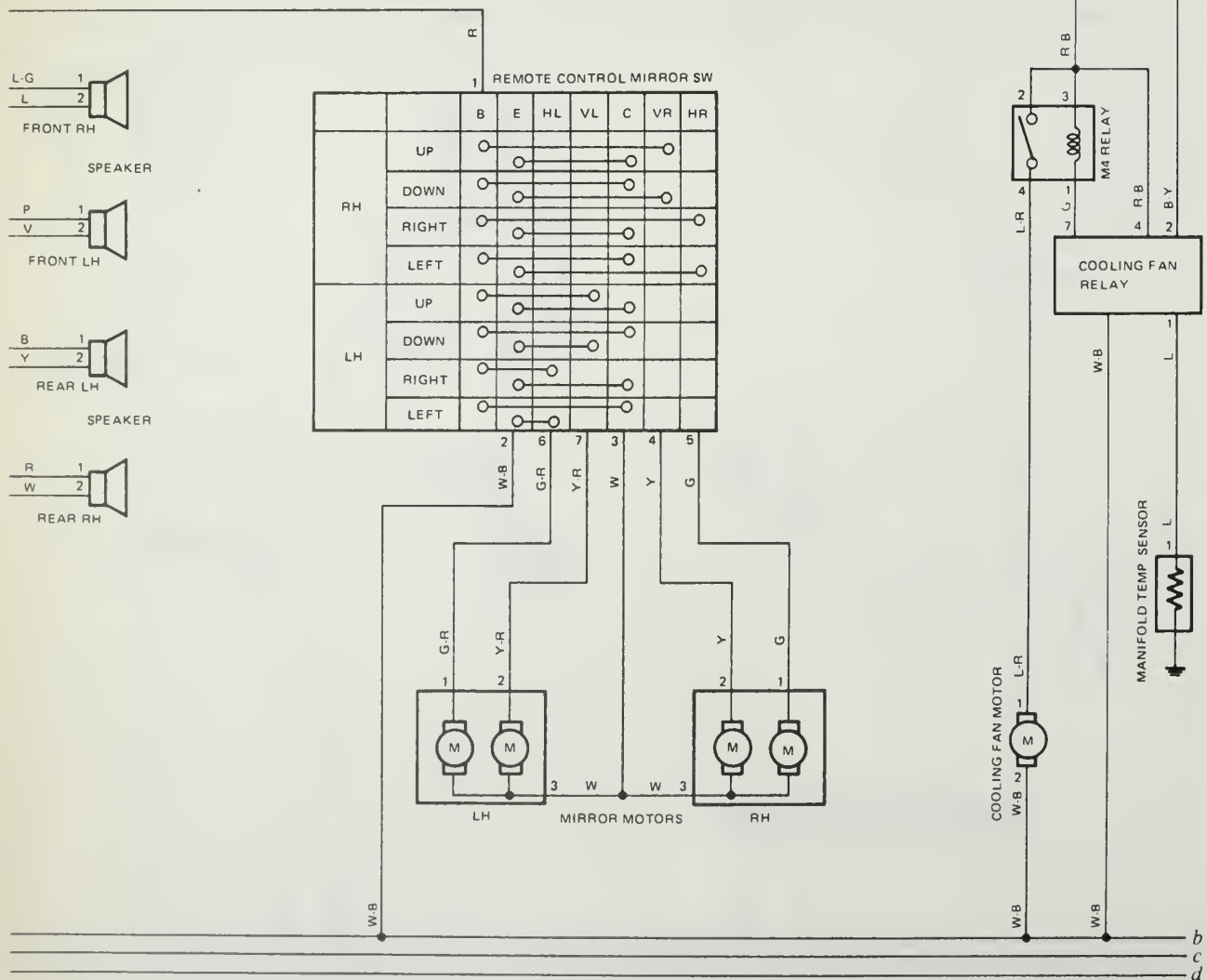
Remote Control Mirrors



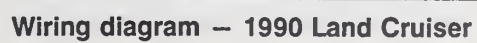
Cooling Fan (Engine)

5

6



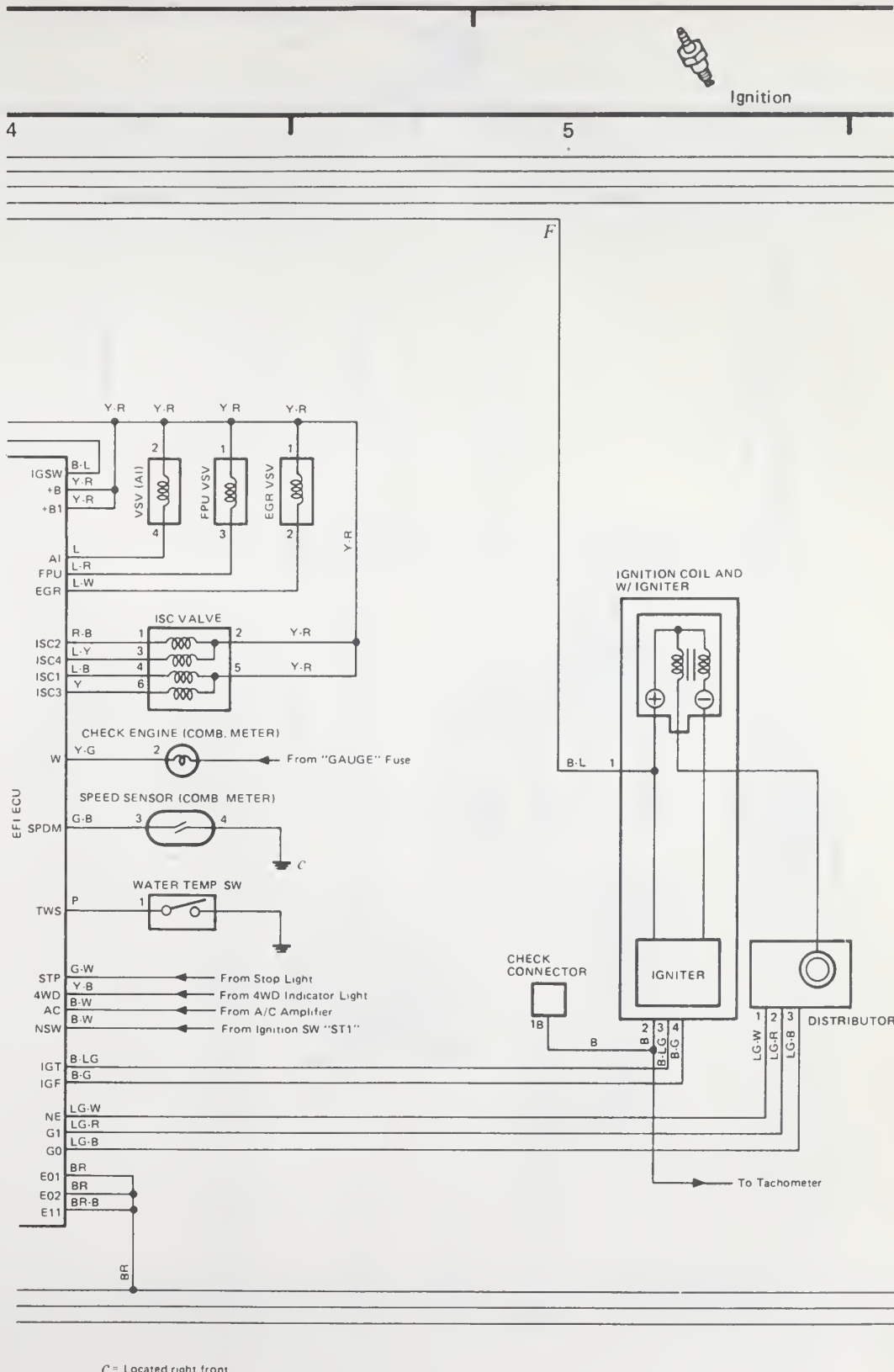
Wiring diagram — 1989 Land Cruiser



[illegible]

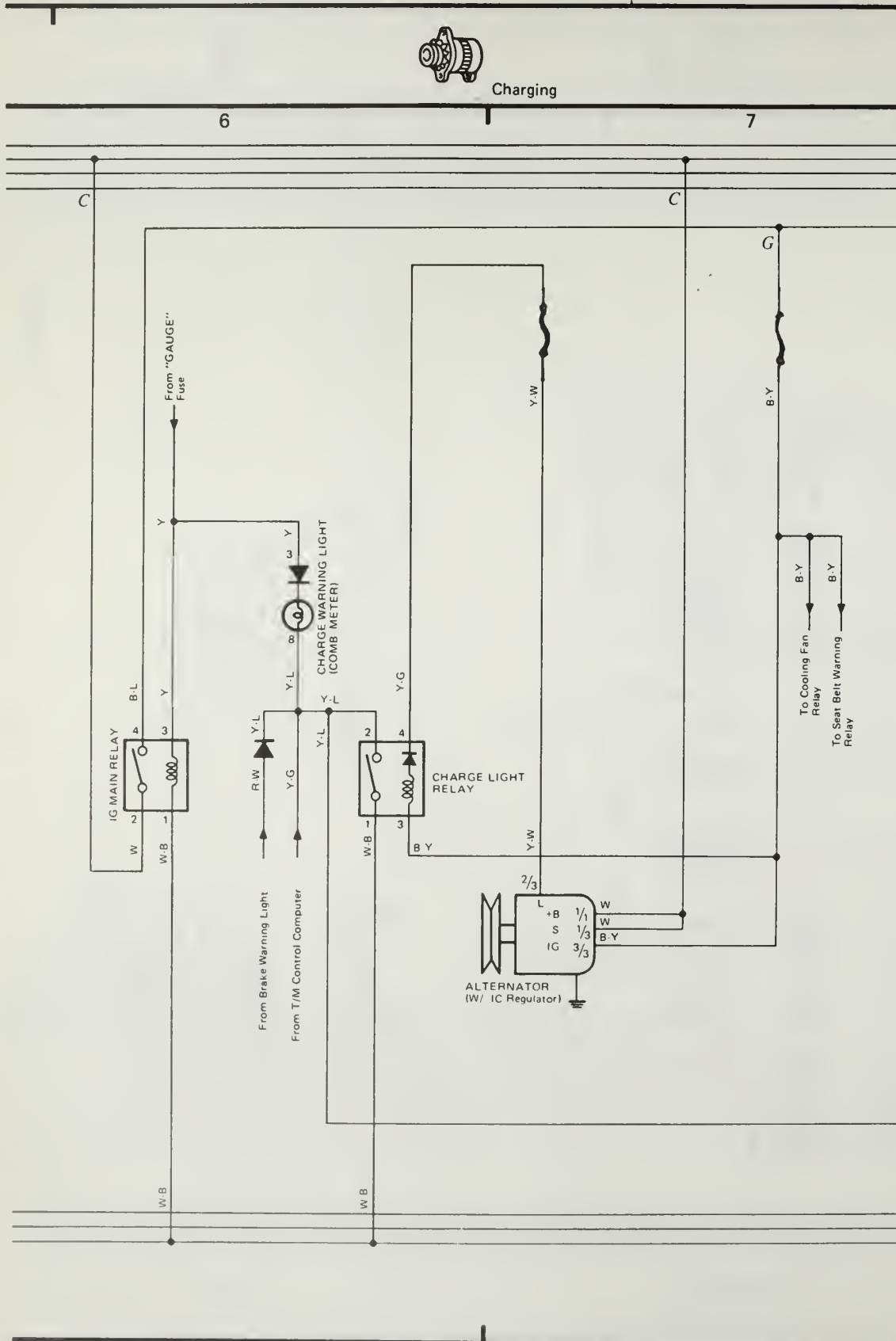
b = Located on left front pillar

6-254

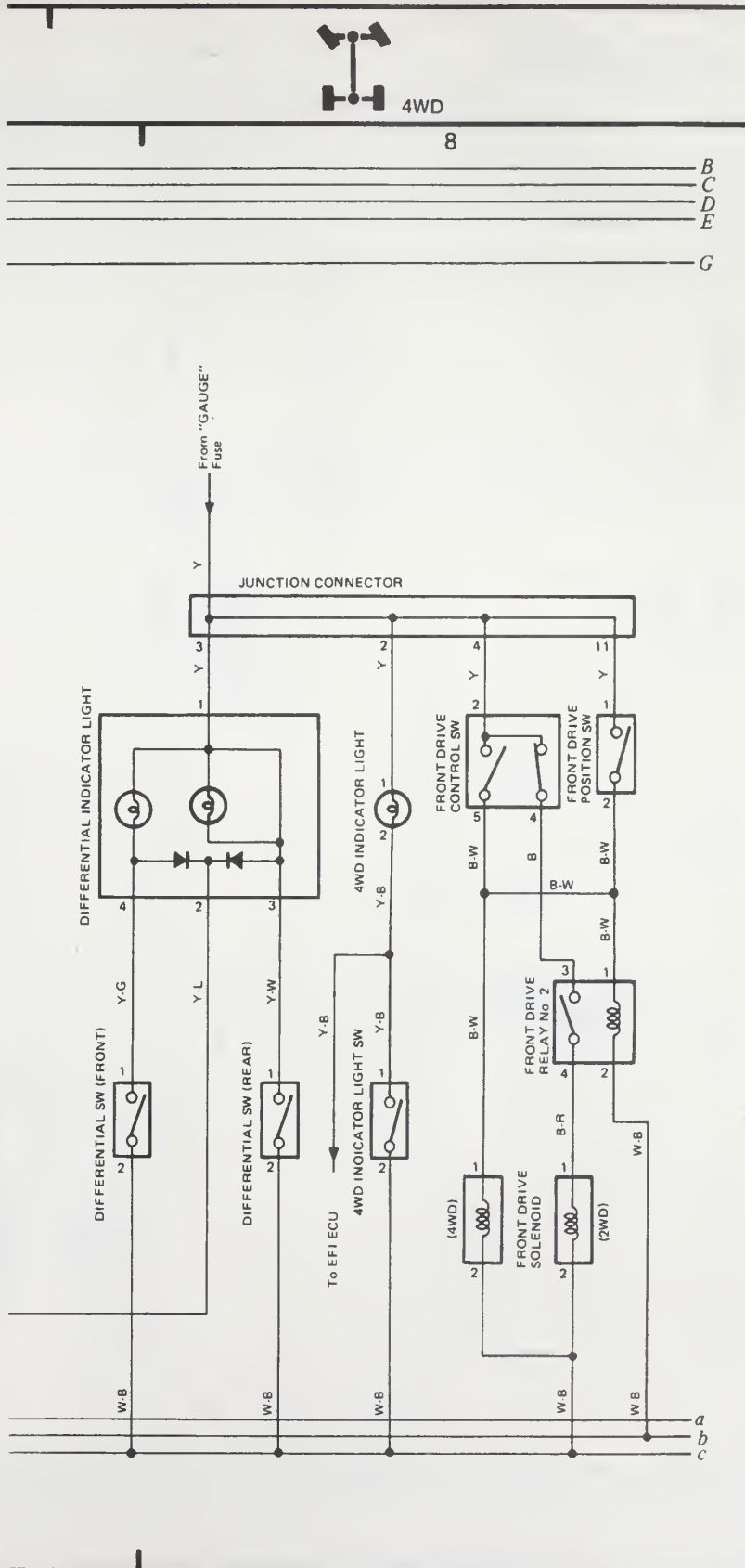


Wiring diagram — 1990 Land Cruiser

6 CHASSIS ELECTRICAL

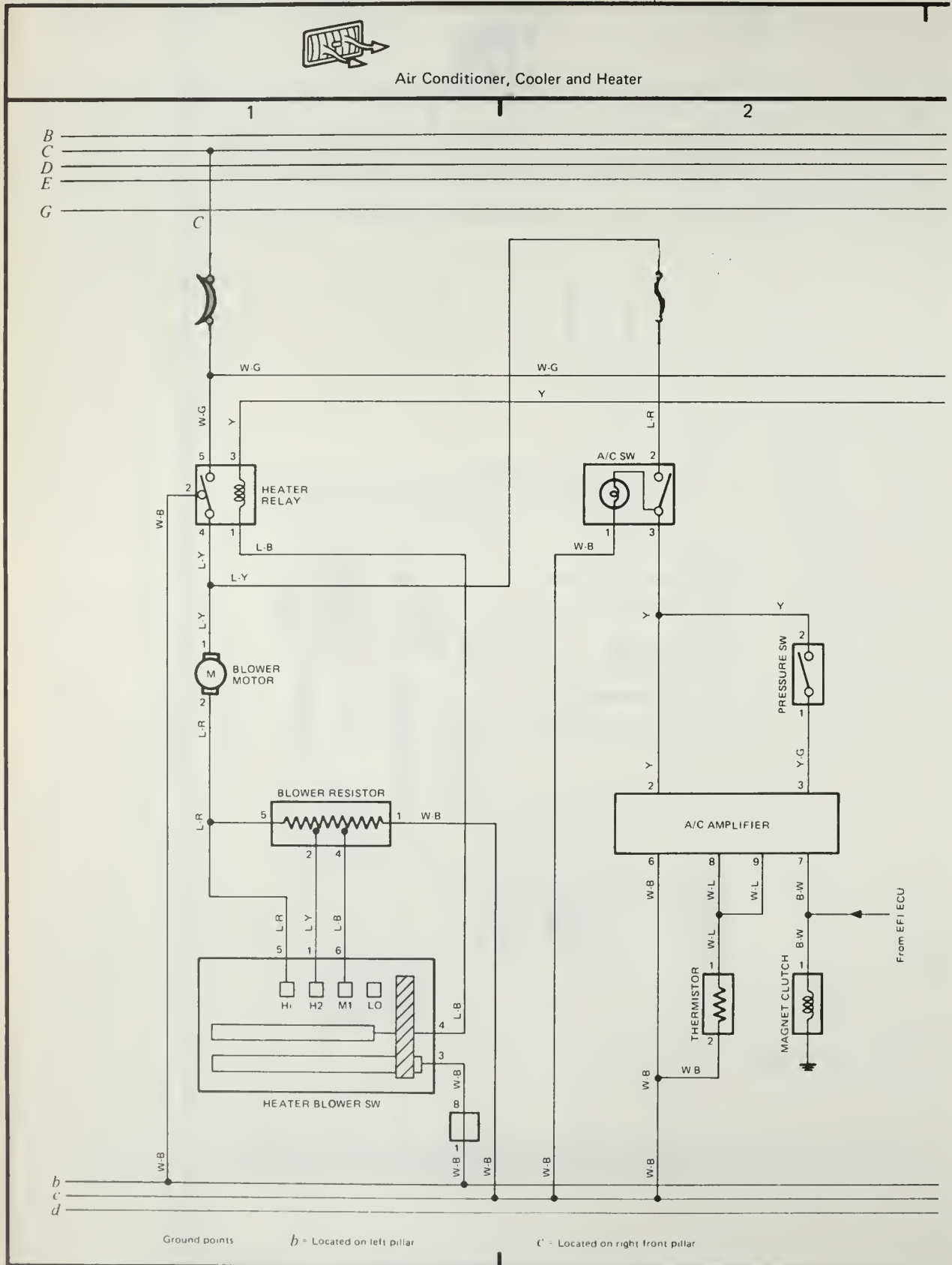


Wiring diagram — 1990 Land Cruiser



Wiring diagram — 1990 Land Cruiser

6 CHASSIS ELECTRICAL



Wiring diagram — 1990 Land Cruiser

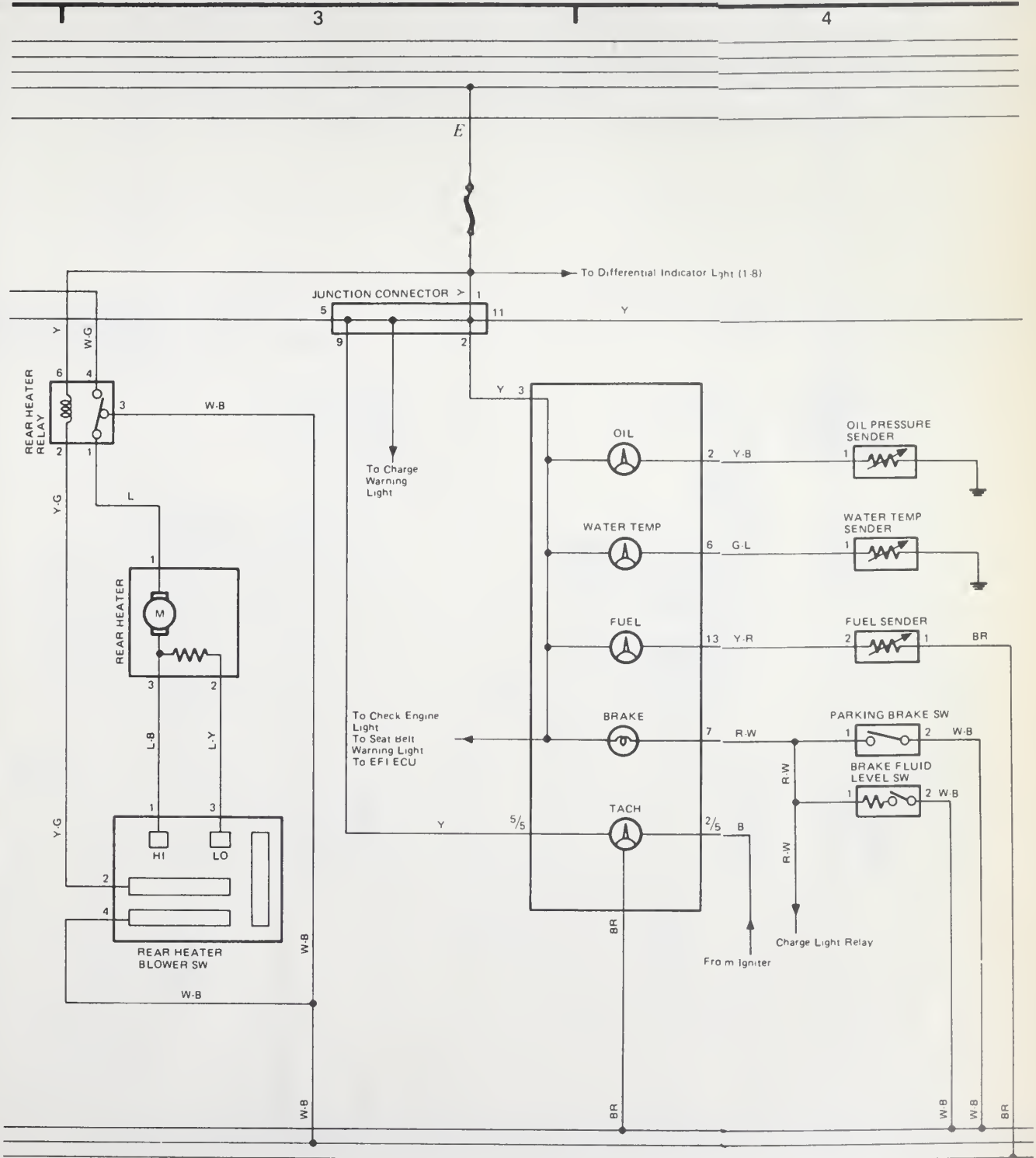
CHASSIS ELECTRICAL 6



Rear Air Conditioner



Combination Meter



d = Located on center of back panel

Wiring diagram — 1990 Land Cruiser

6 CHASSIS ELECTRICAL



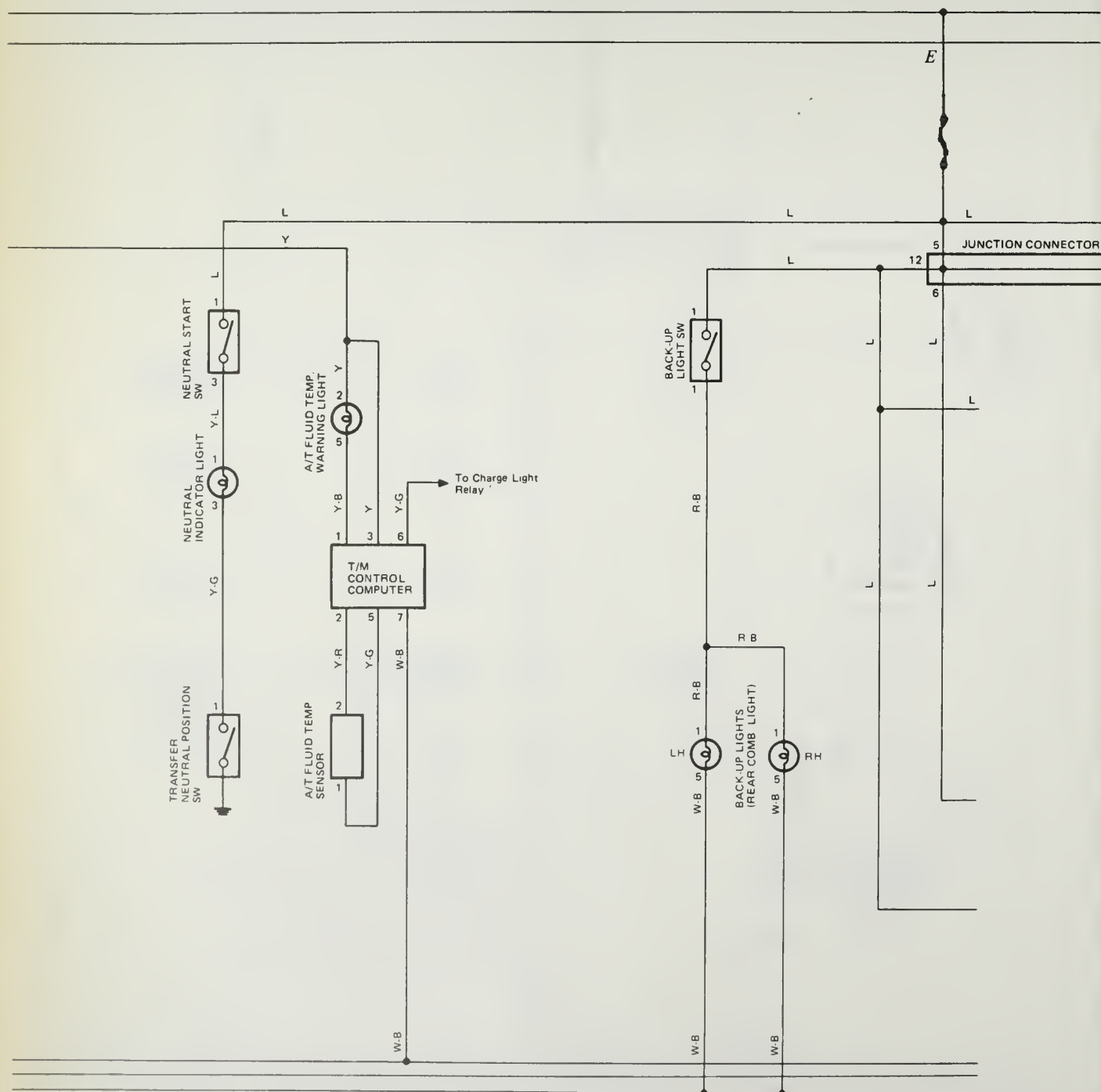
A/T Fluid Temp. Warning



Back-up Lights

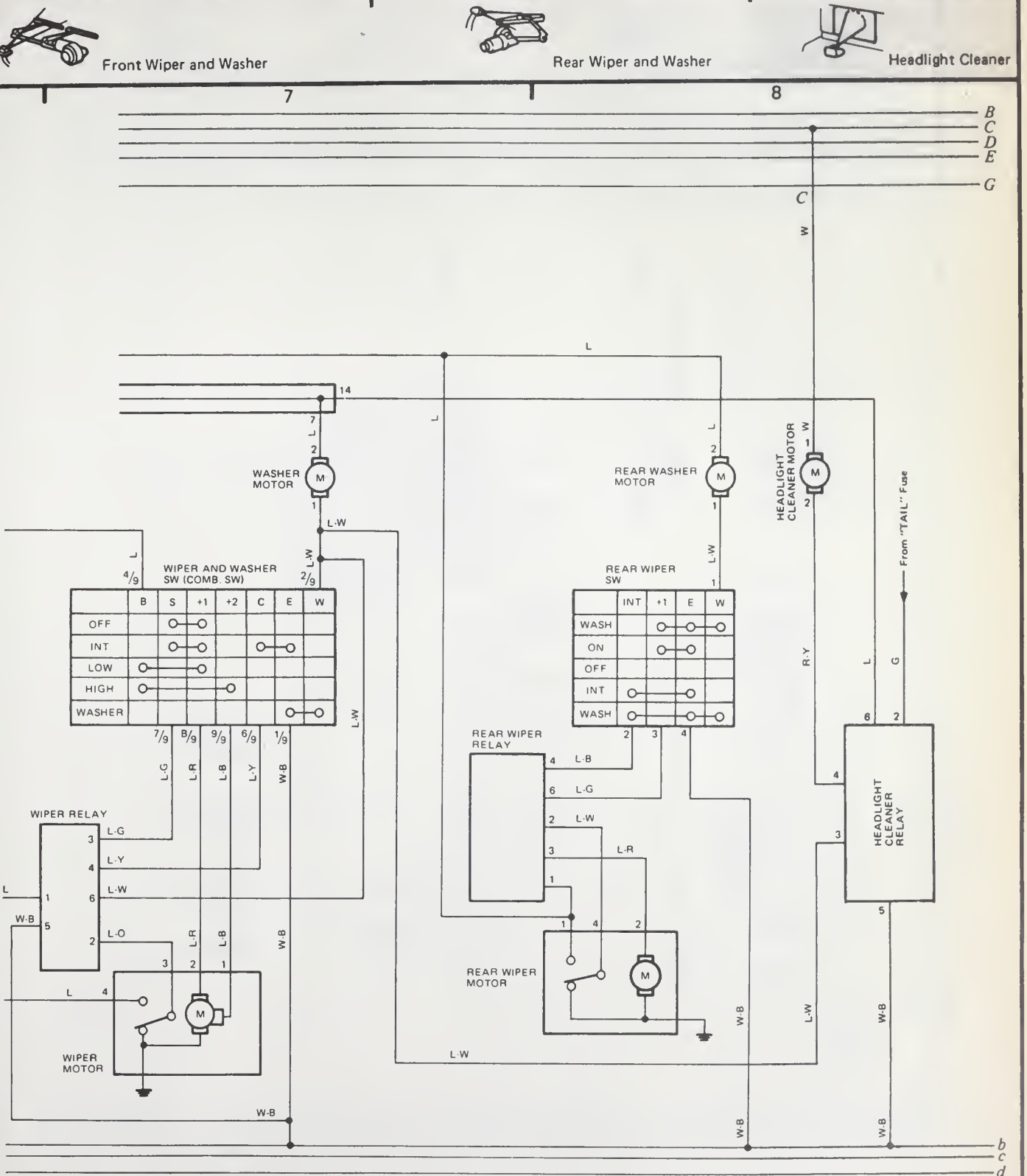
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6



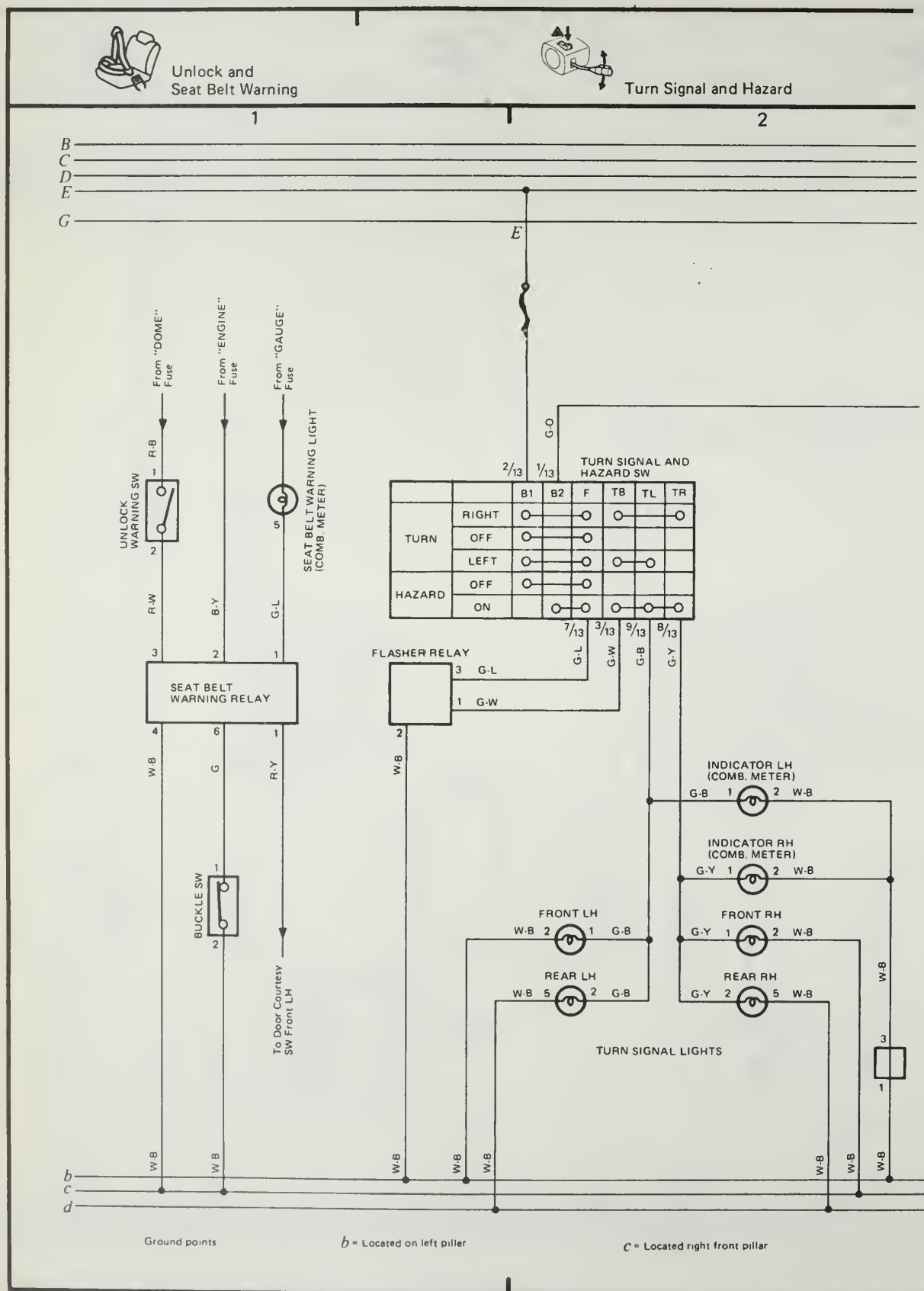
Wiring diagram — 1990 Land Cruiser

6



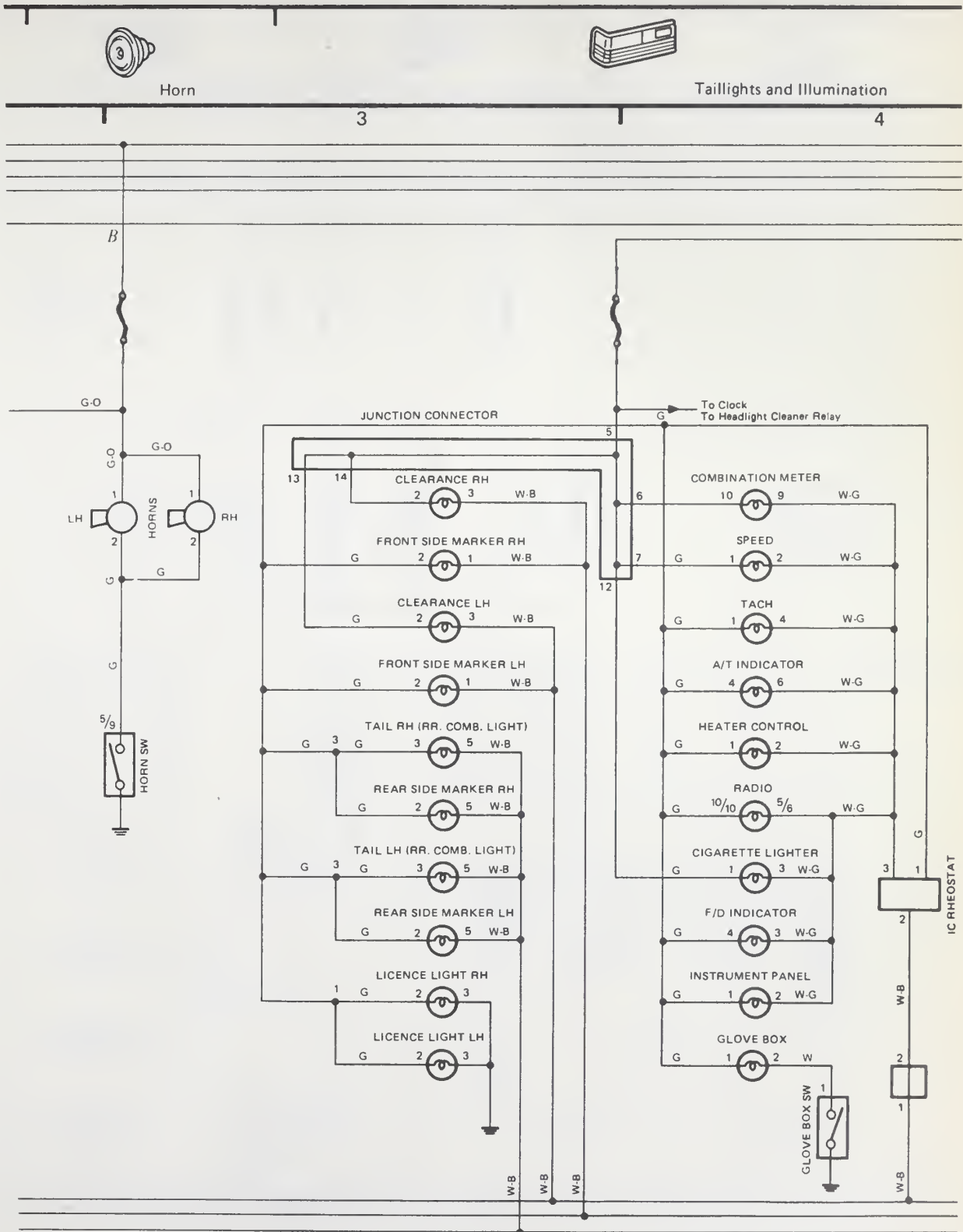
Wiring diagram – 1990 Land Cruiser

6 CHASSIS ELECTRICAL



Wiring diagram — 1990 Land Cruiser

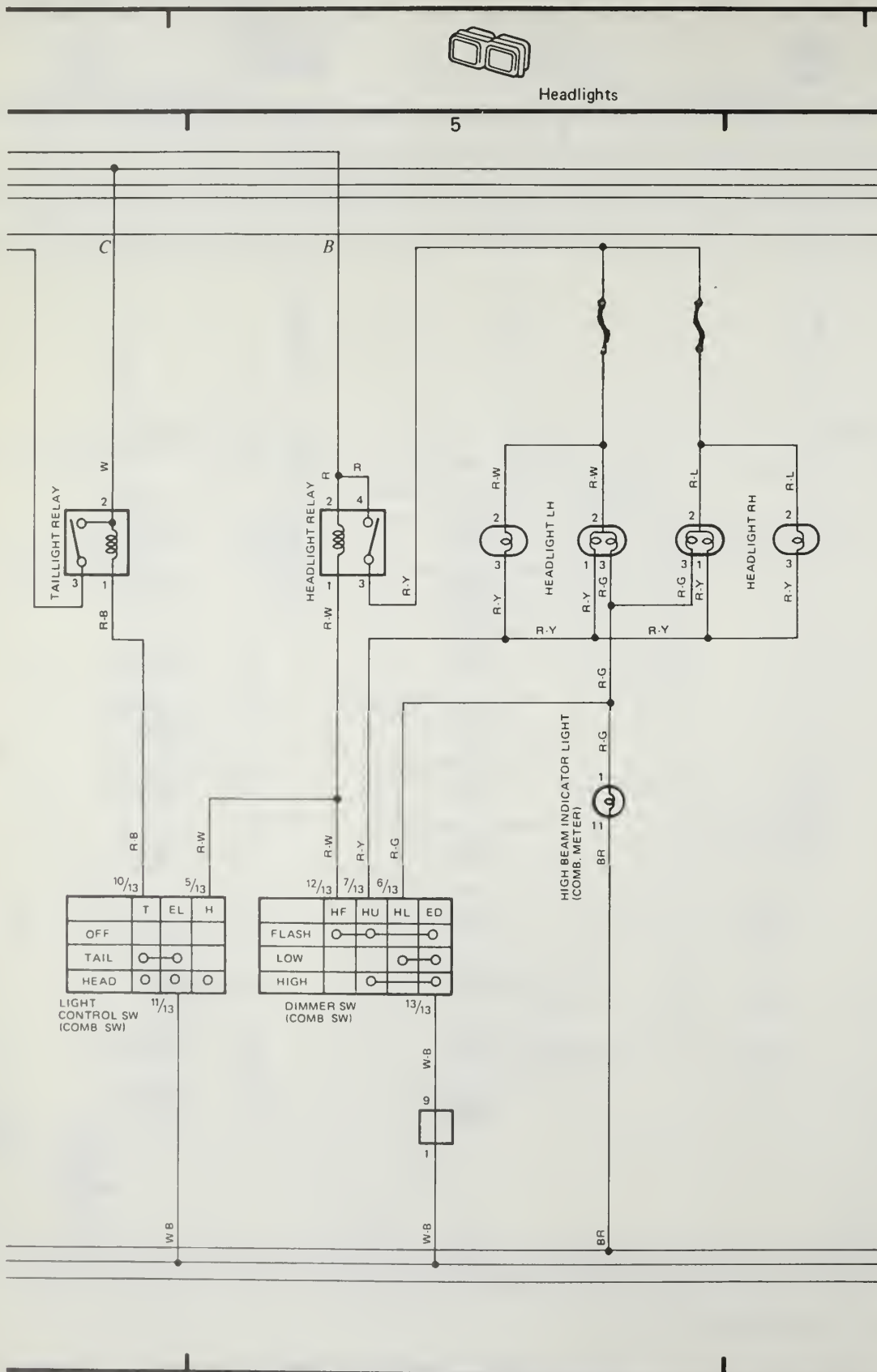
CHASSIS ELECTRICAL 6



d = Located on center of back panel

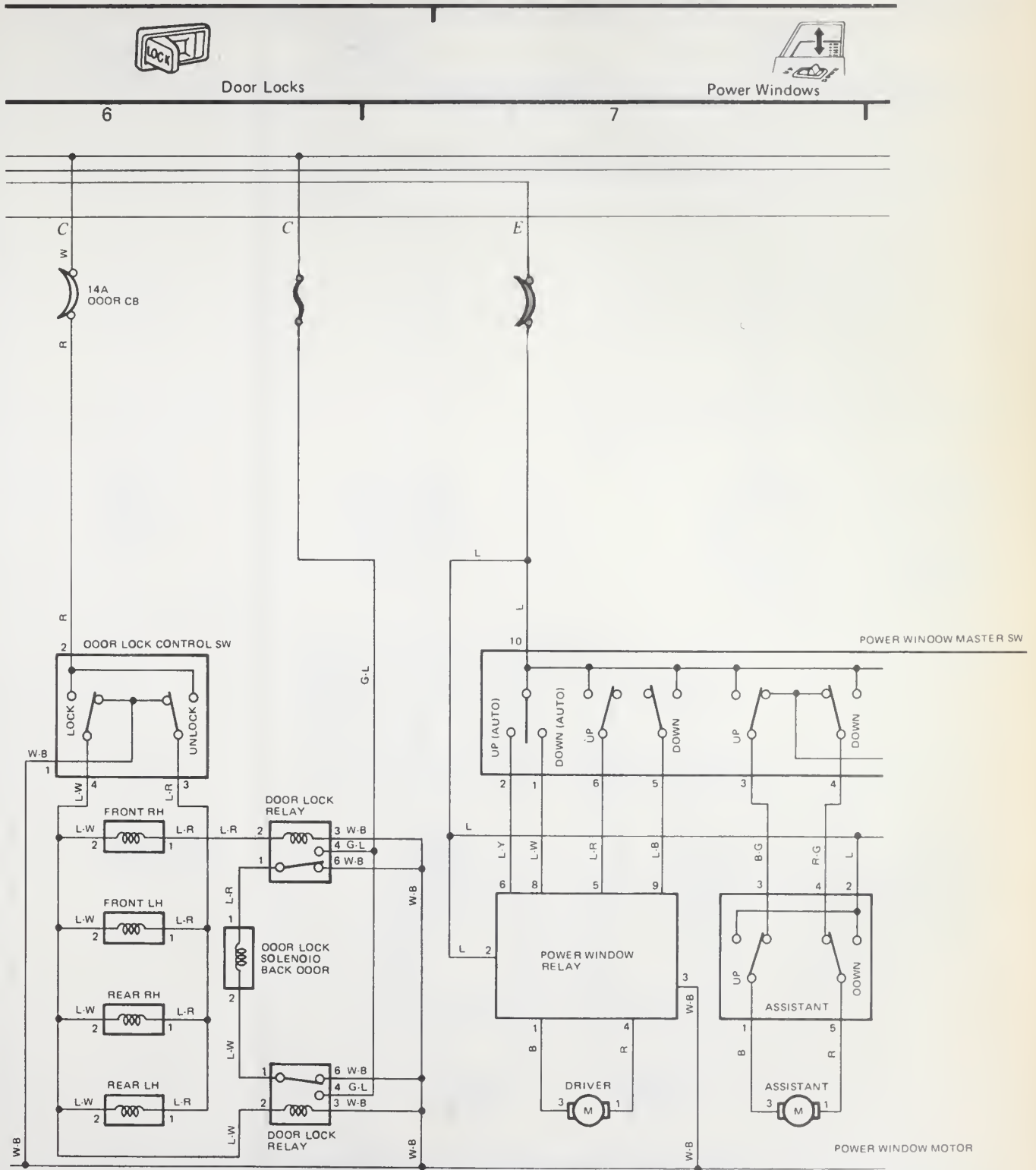
Wiring diagram — 1990 Land Cruiser

6 CHASSIS ELECTRICAL



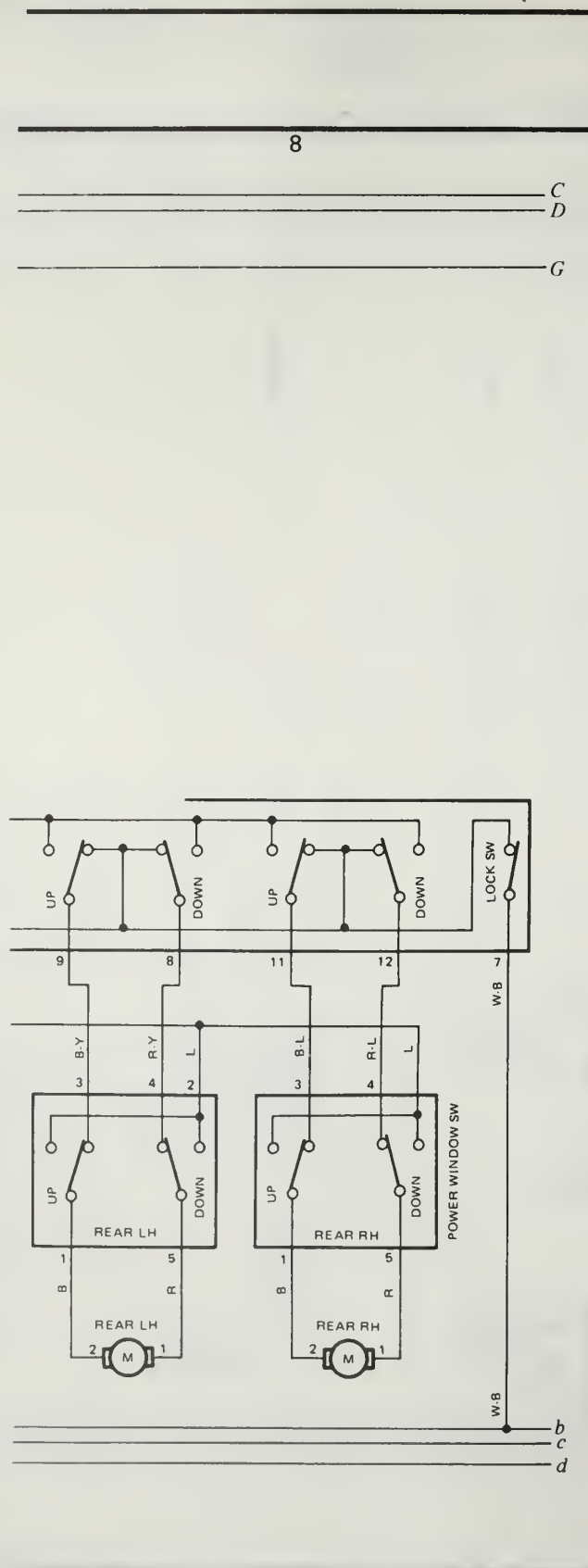
Wiring diagram — 1990 Land Cruiser

CHASSIS ELECTRICAL 6

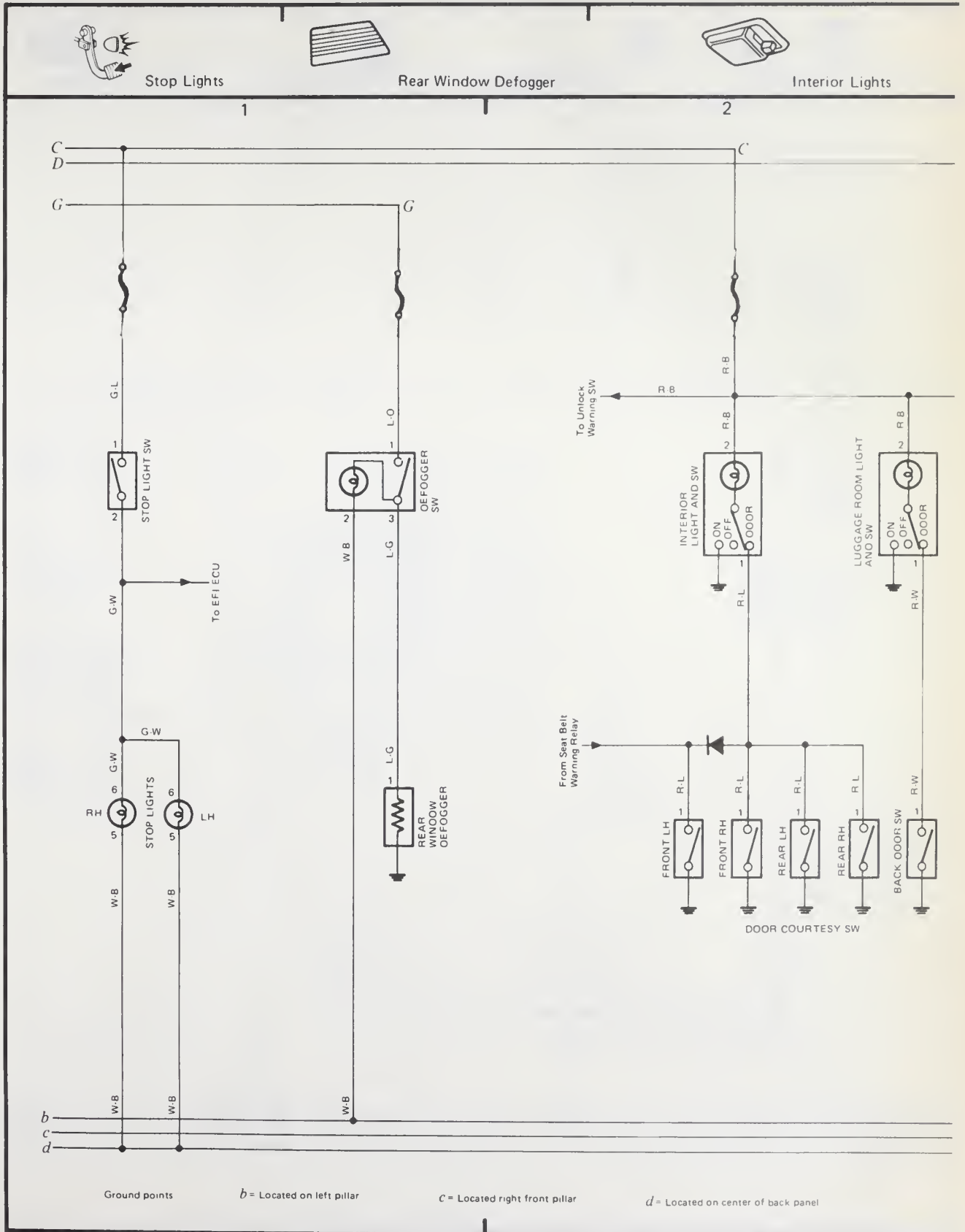


Wiring diagram – 1990 Land Cruiser

6 CHASSIS ELECTRICAL

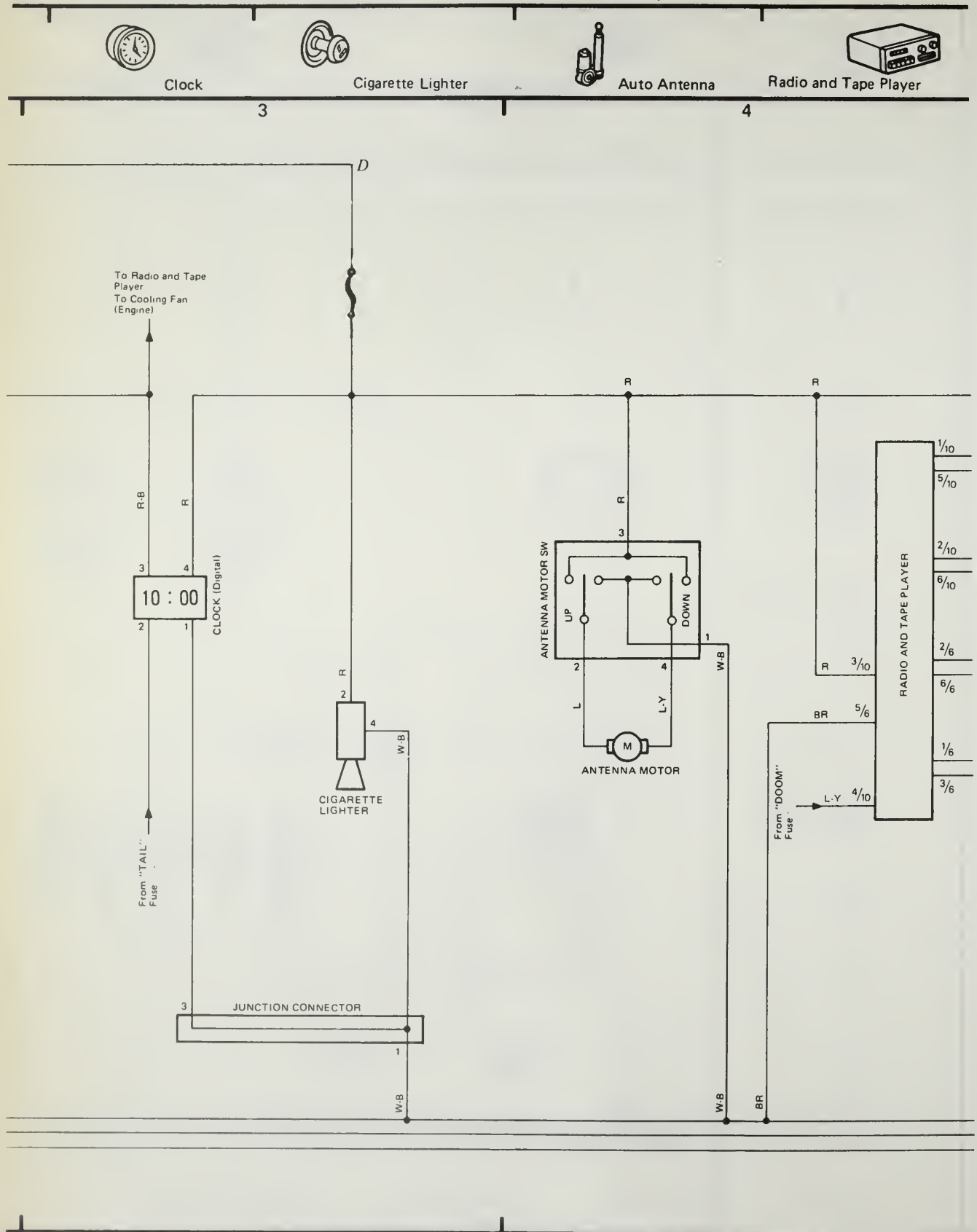


Wiring diagram — 1990 Land Cruiser

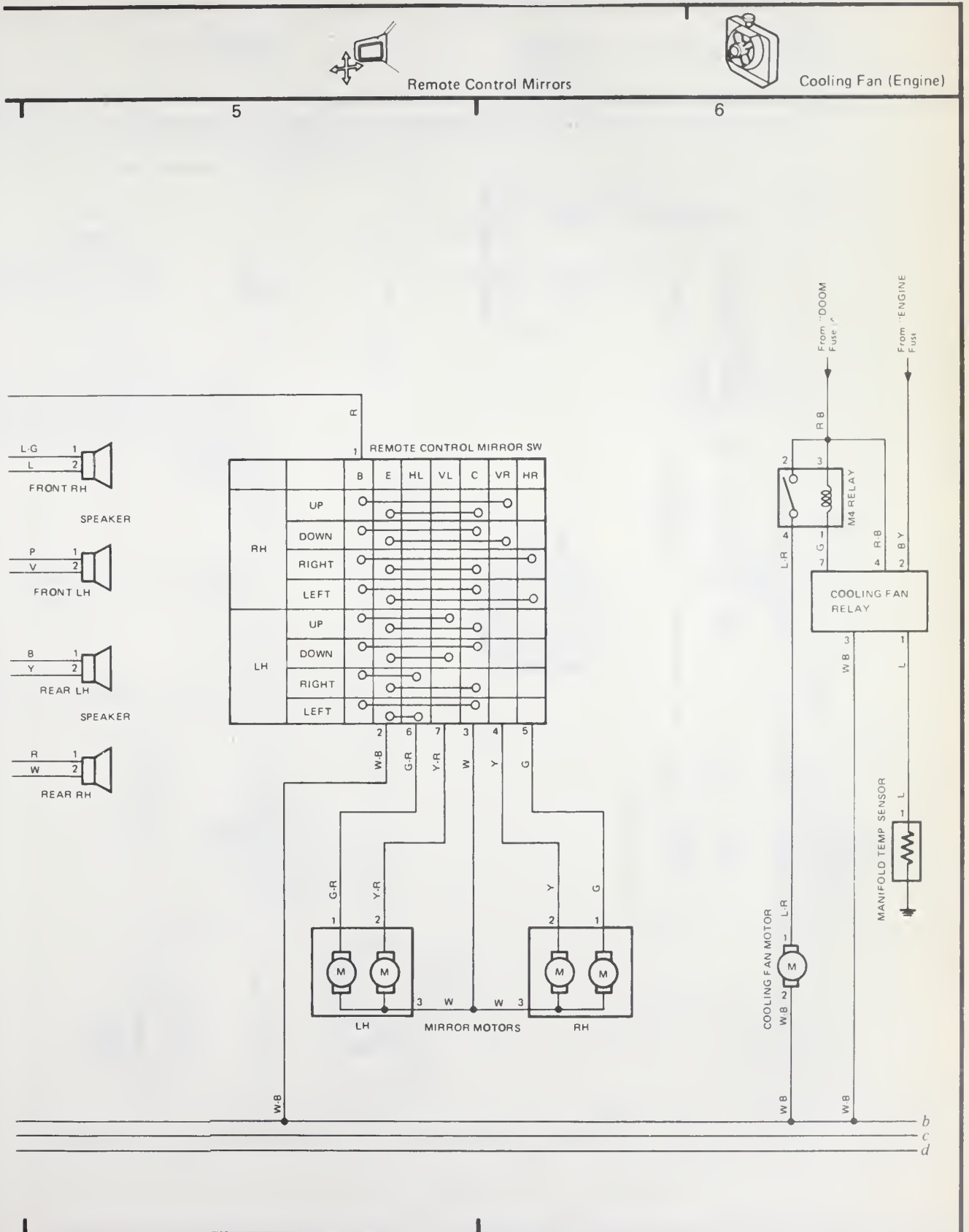


Wiring diagram — 1990 Land Cruiser

6 CHASSIS ELECTRICAL

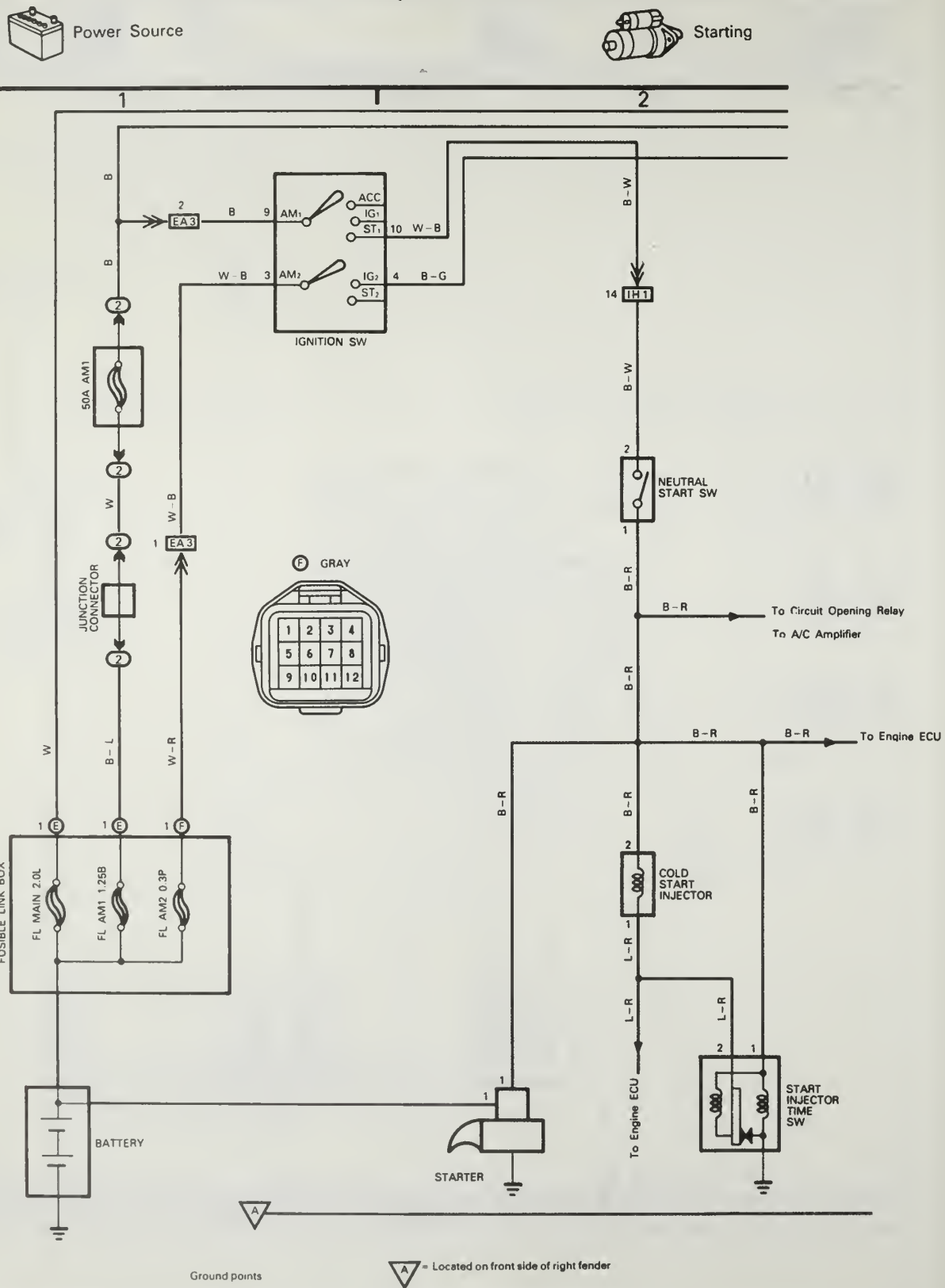


Wiring diagram — 1990 Land Cruiser



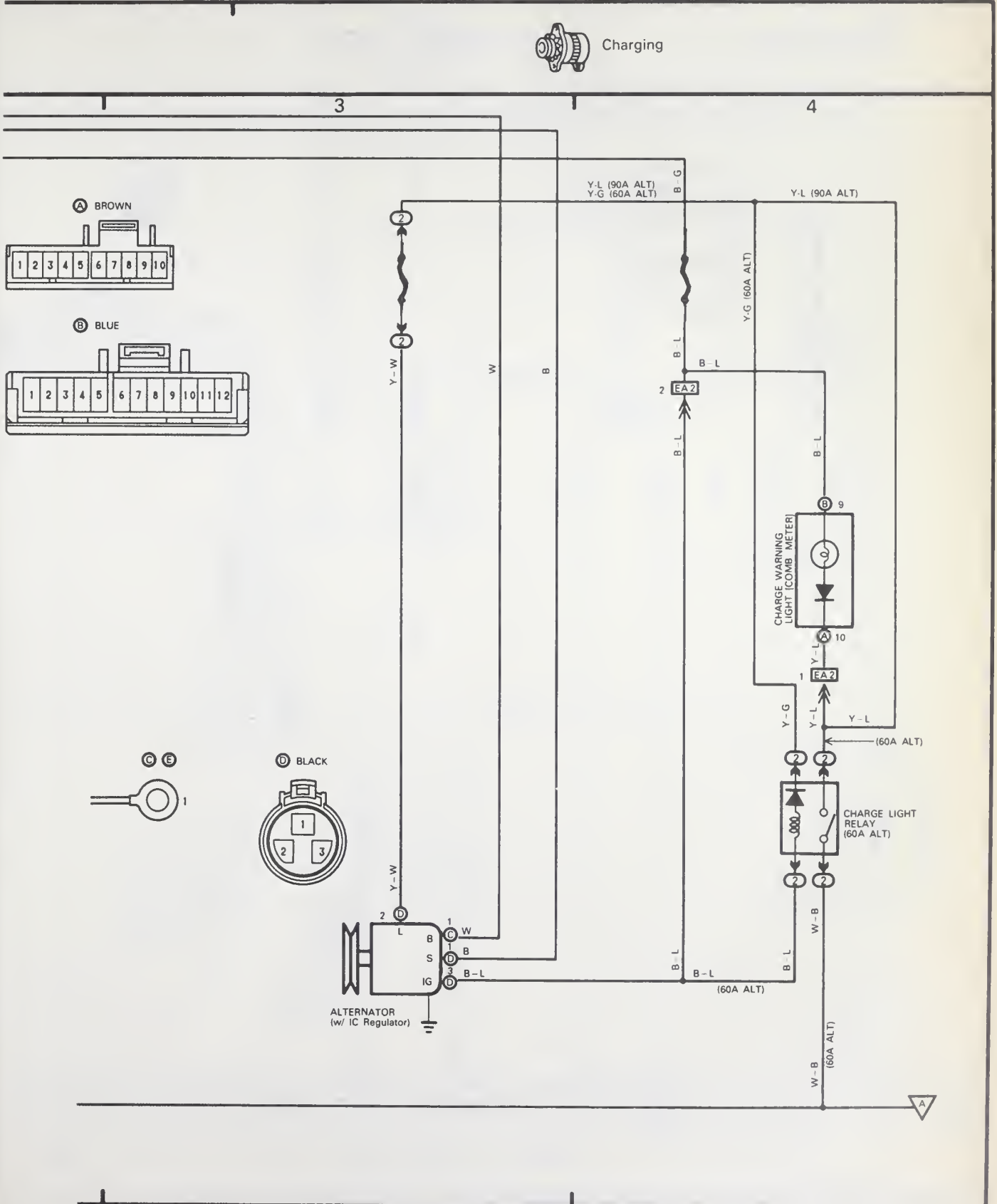
Wiring diagram — 1990 Land Cruiser

6 CHASSIS ELECTRICAL



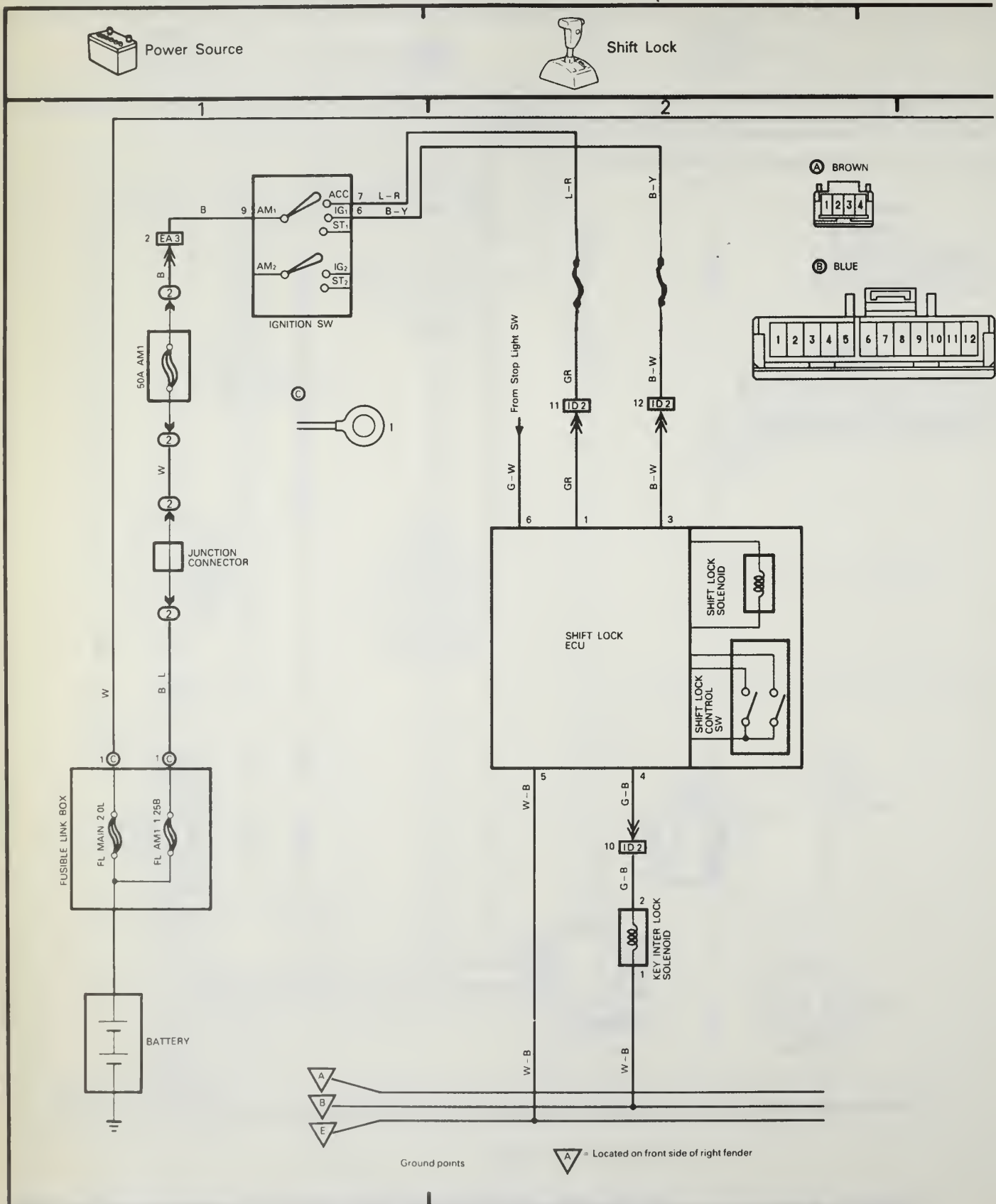
Wiring diagram – 1991 Land Cruiser

CHASSIS ELECTRICAL 6

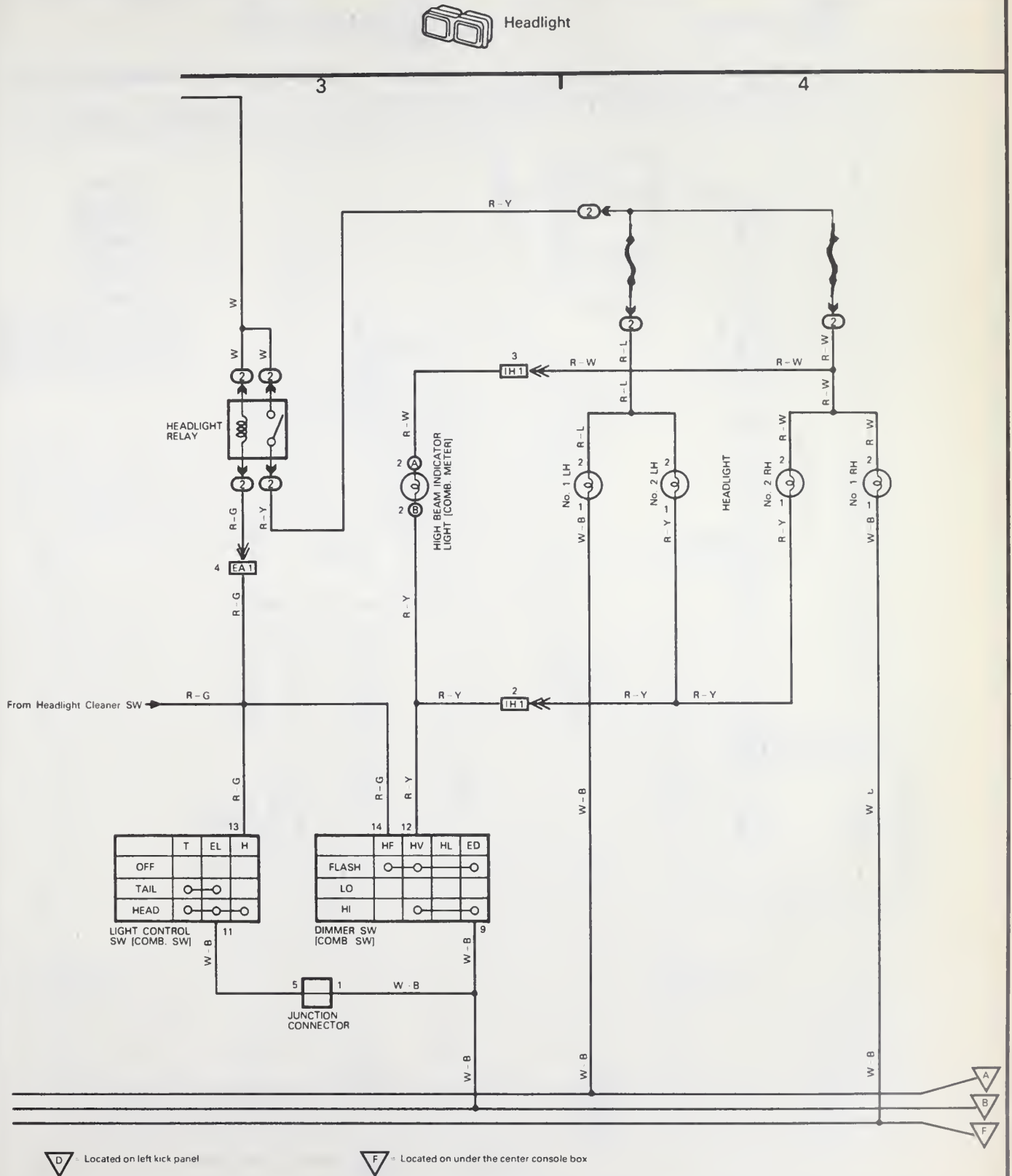


Wiring diagram — 1991 Land Cruiser

6 CHASSIS ELECTRICAL

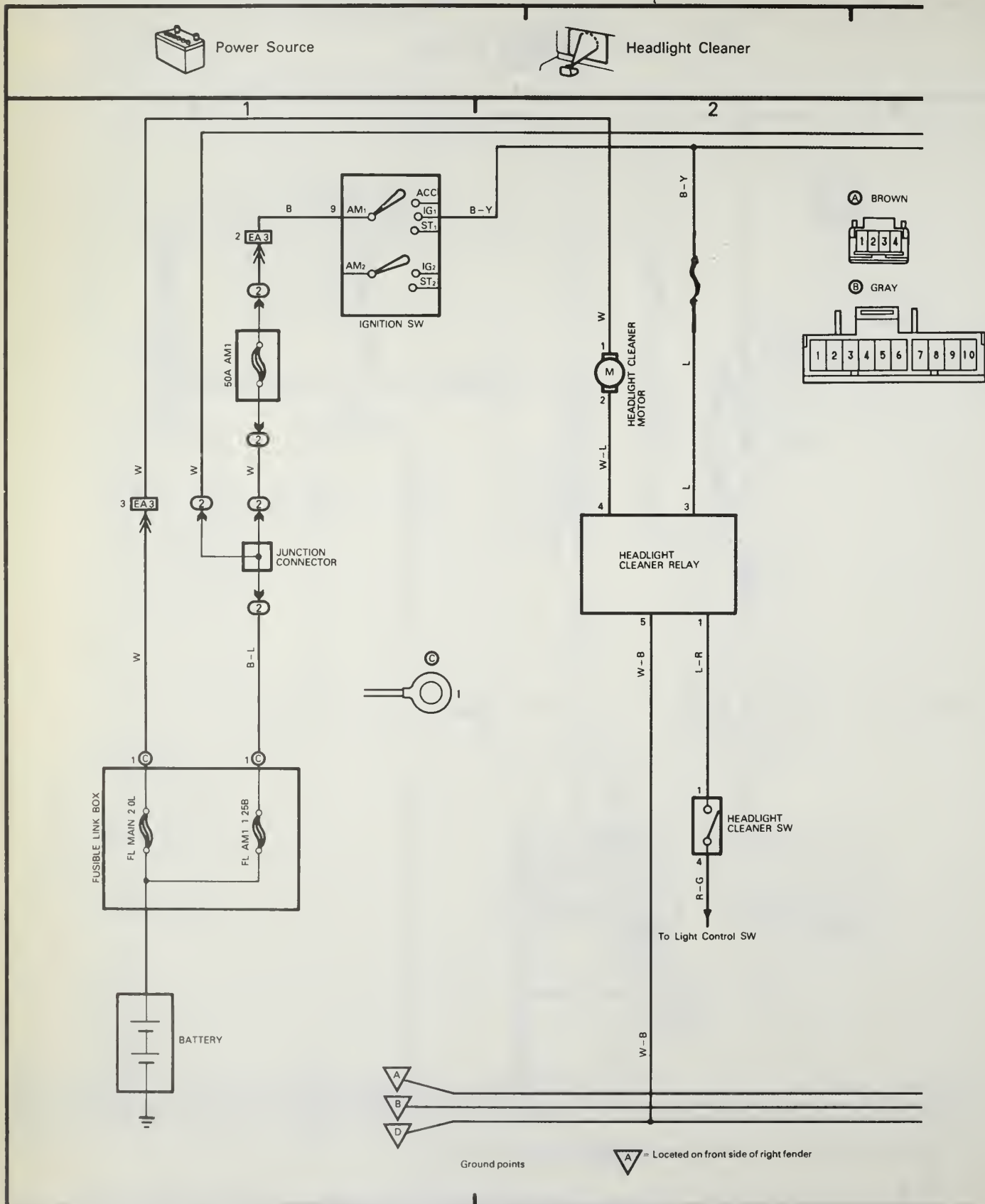


Wiring diagram – 1991 Land Cruiser



Wiring diagram — 1991 Land Cruiser

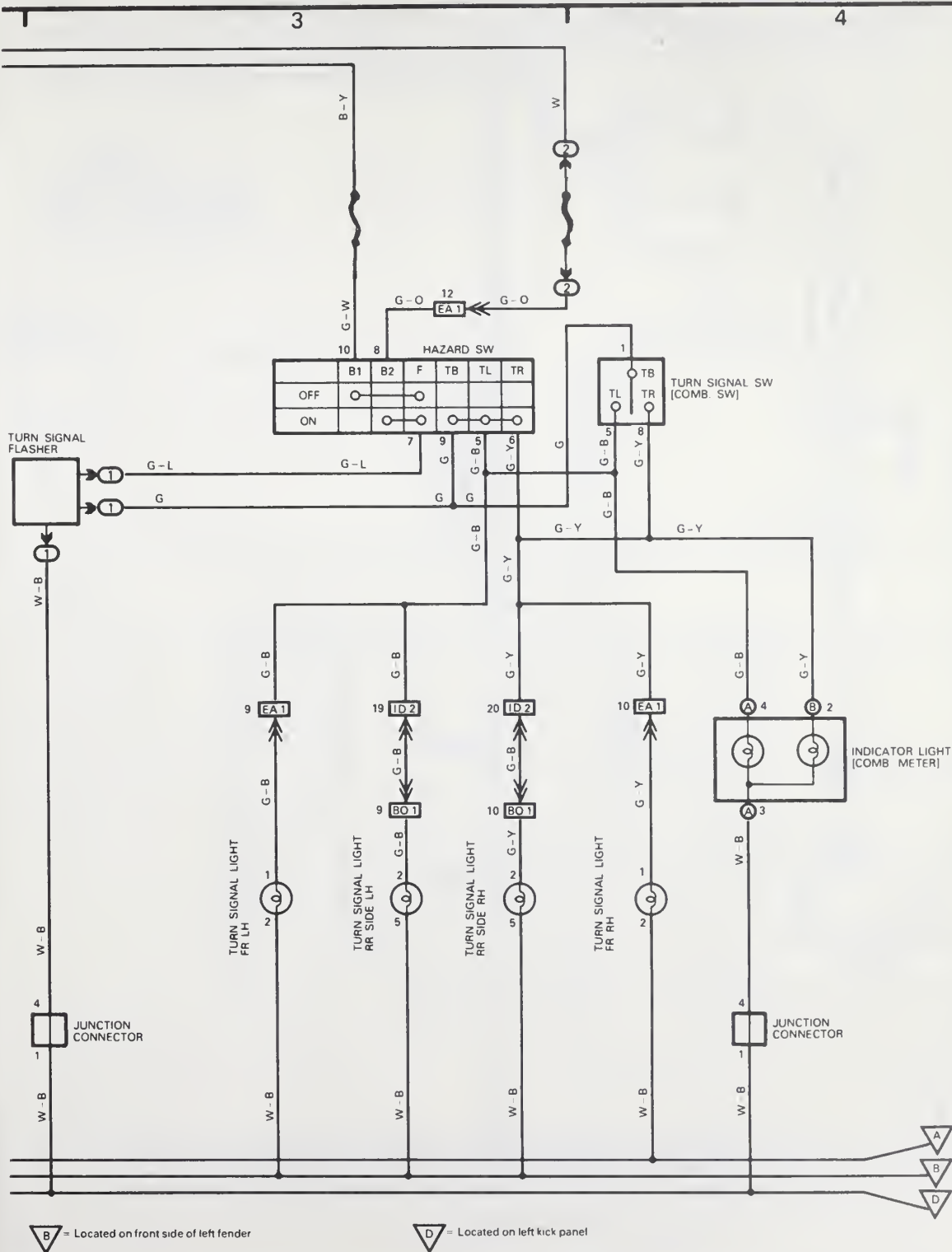
6 CHASSIS ELECTRICAL



Wiring diagram — 1991 Land Cruiser

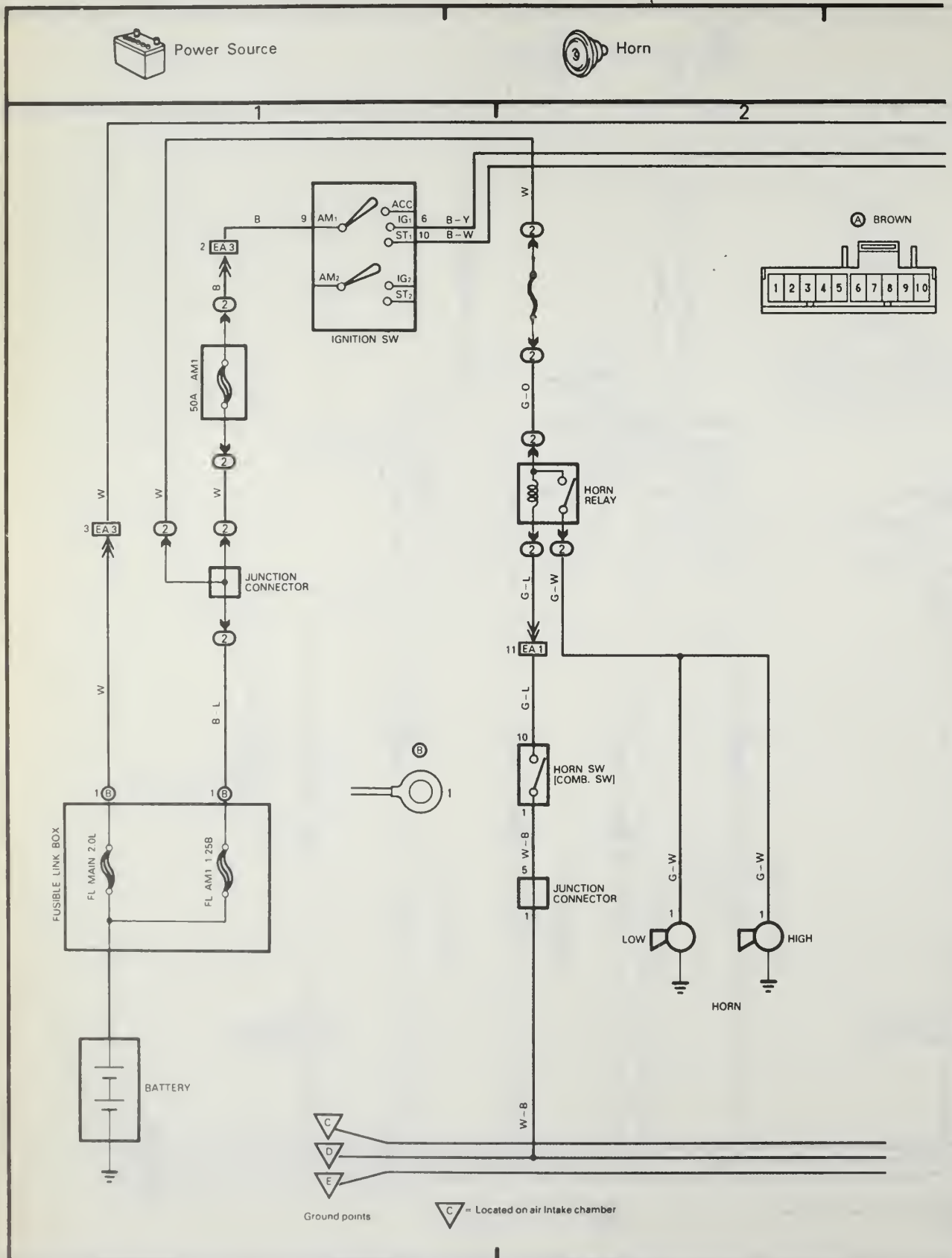


Turn Signal and Hazard

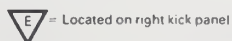


Wiring diagram — 1991 Land Cruiser

6 CHASSIS ELECTRICAL

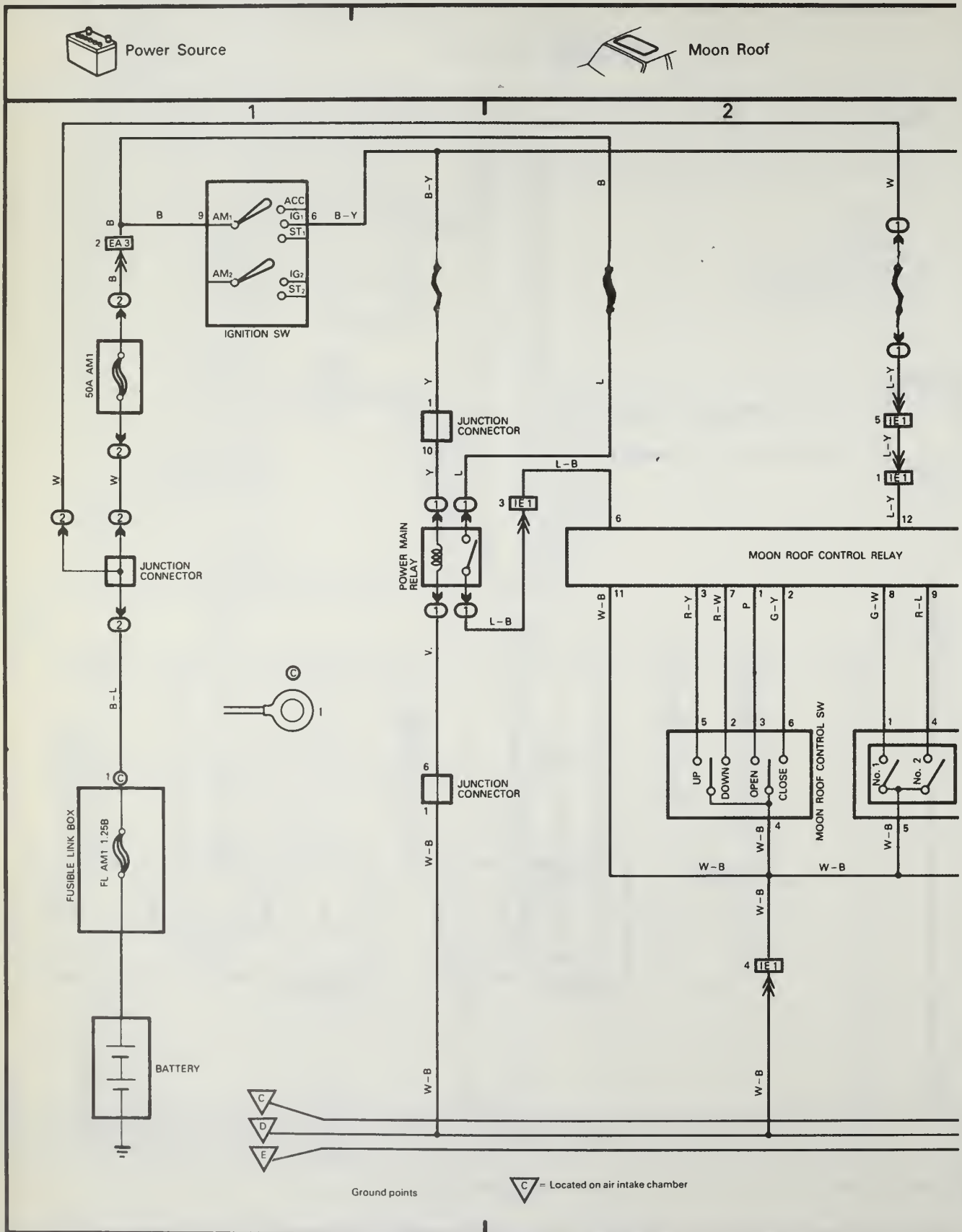


Wiring diagram — 1991 Land Cruiser

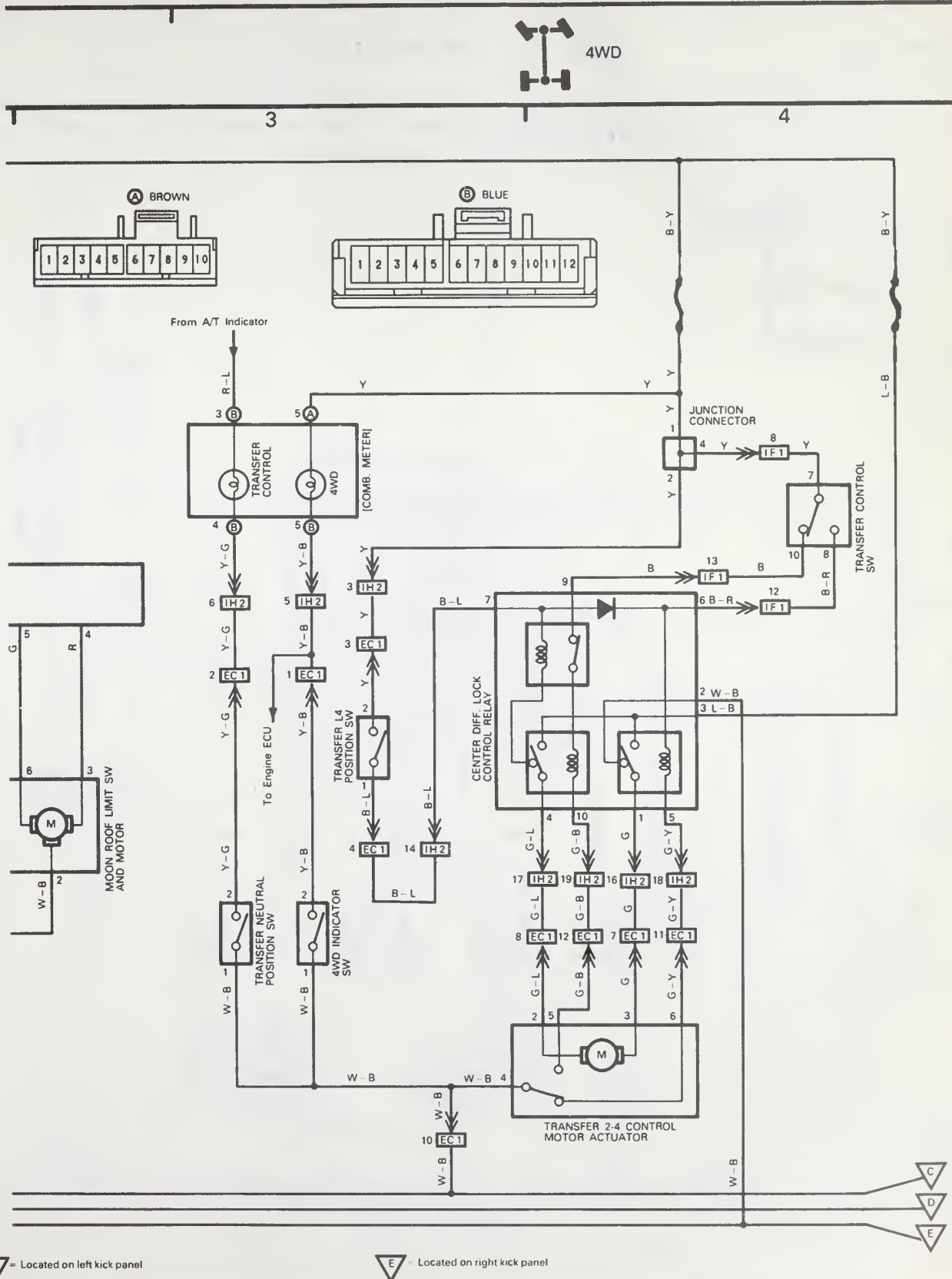


6-277

6 CHASSIS ELECTRICAL

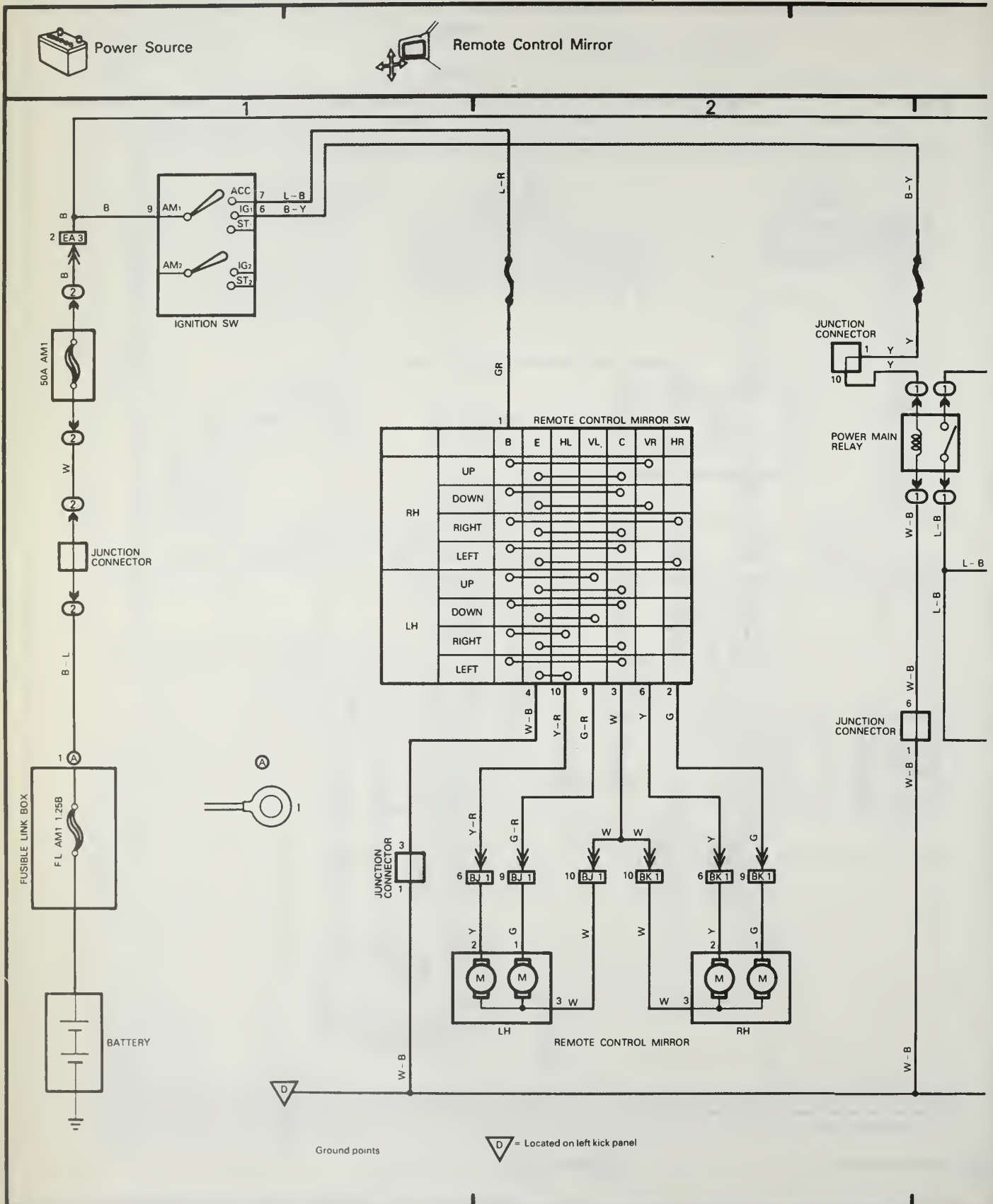


Wiring diagram - 1991 Land Cruiser

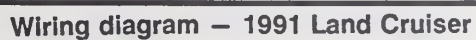


Wiring diagram — 1991 Land Cruiser

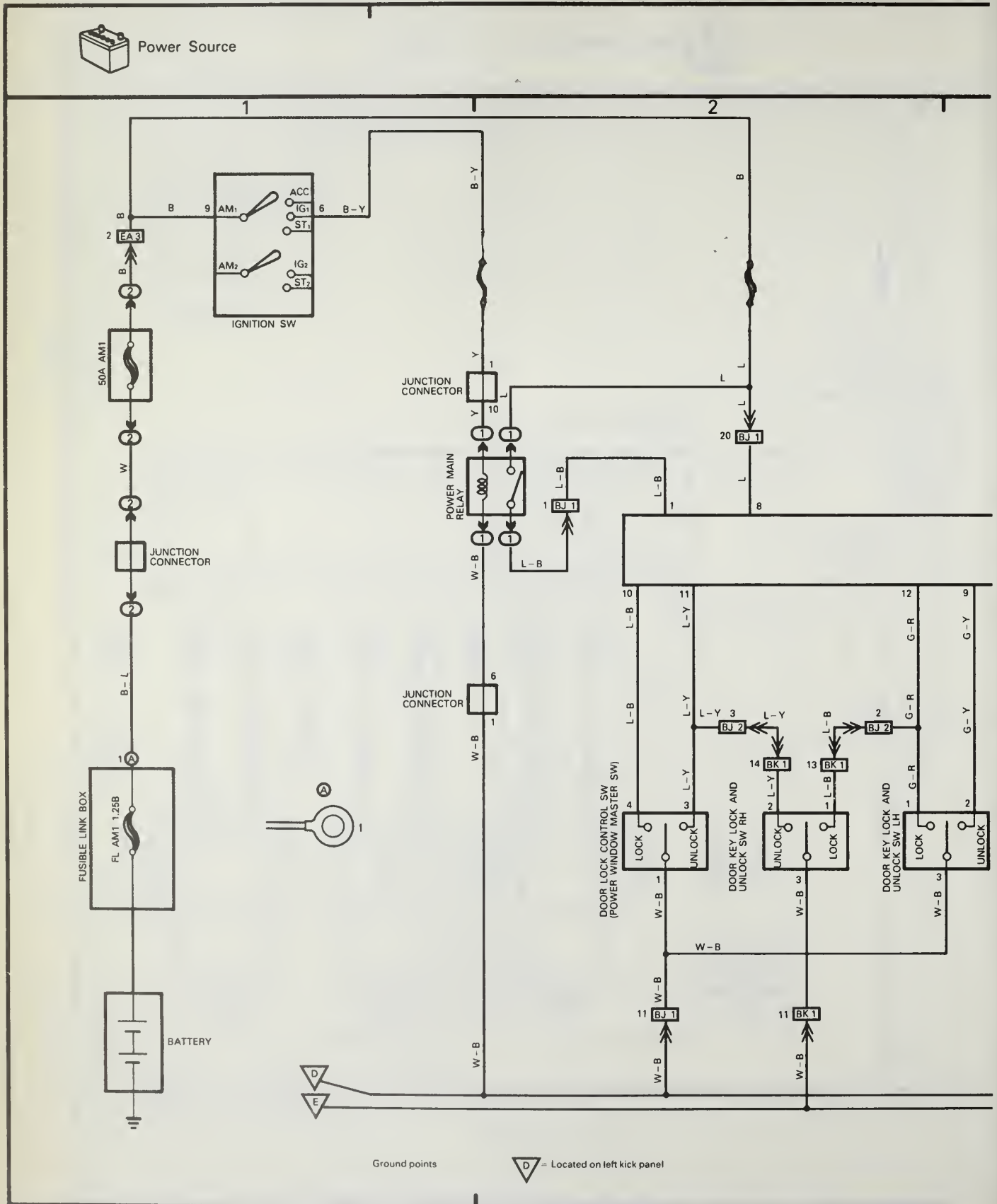
6 CHASSIS ELECTRICAL



Wiring diagram — 1991 Land Cruiser



6 CHASSIS ELECTRICAL



Wiring diagram — 1991 Land Cruiser

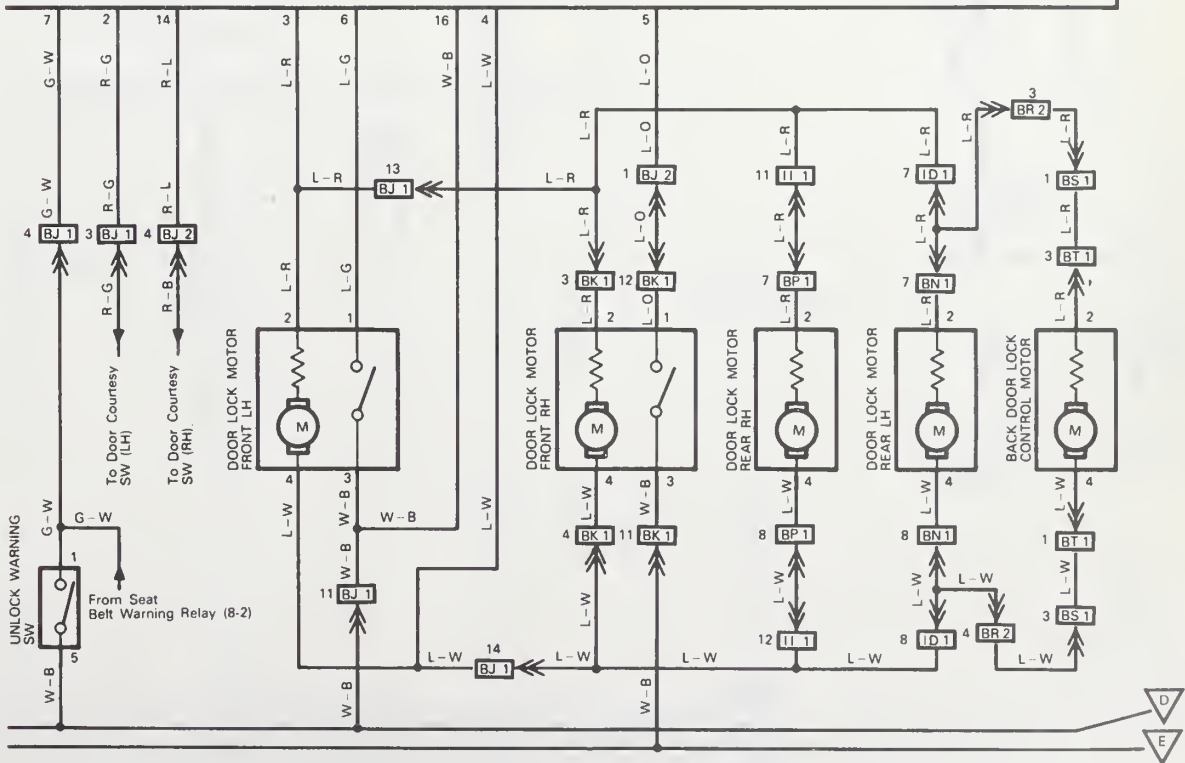


Door Lock

3

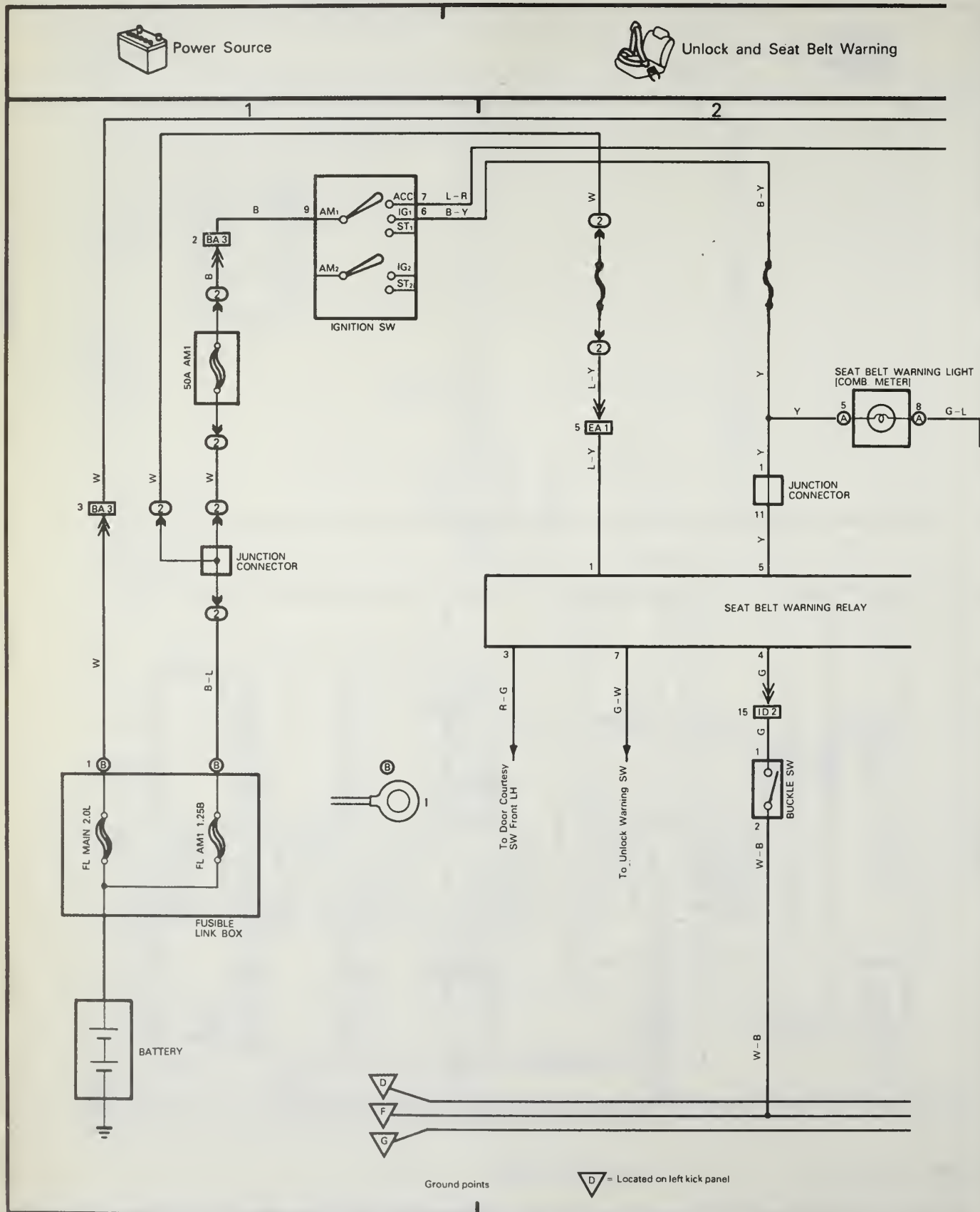
4

DOOR LOCK CONTROL RELAY



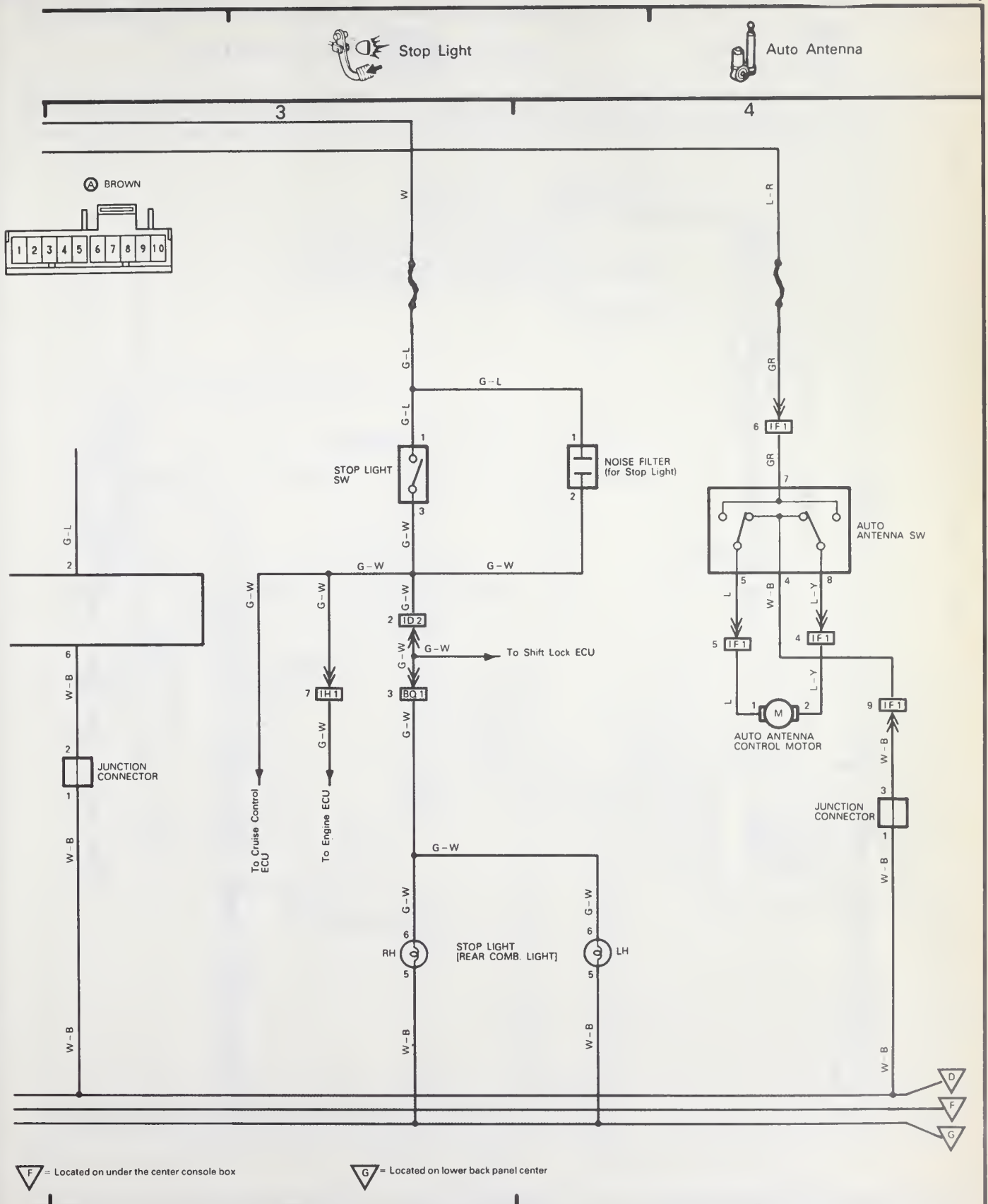
Wiring diagram — 1991 Land Cruiser

6 CHASSIS ELECTRICAL



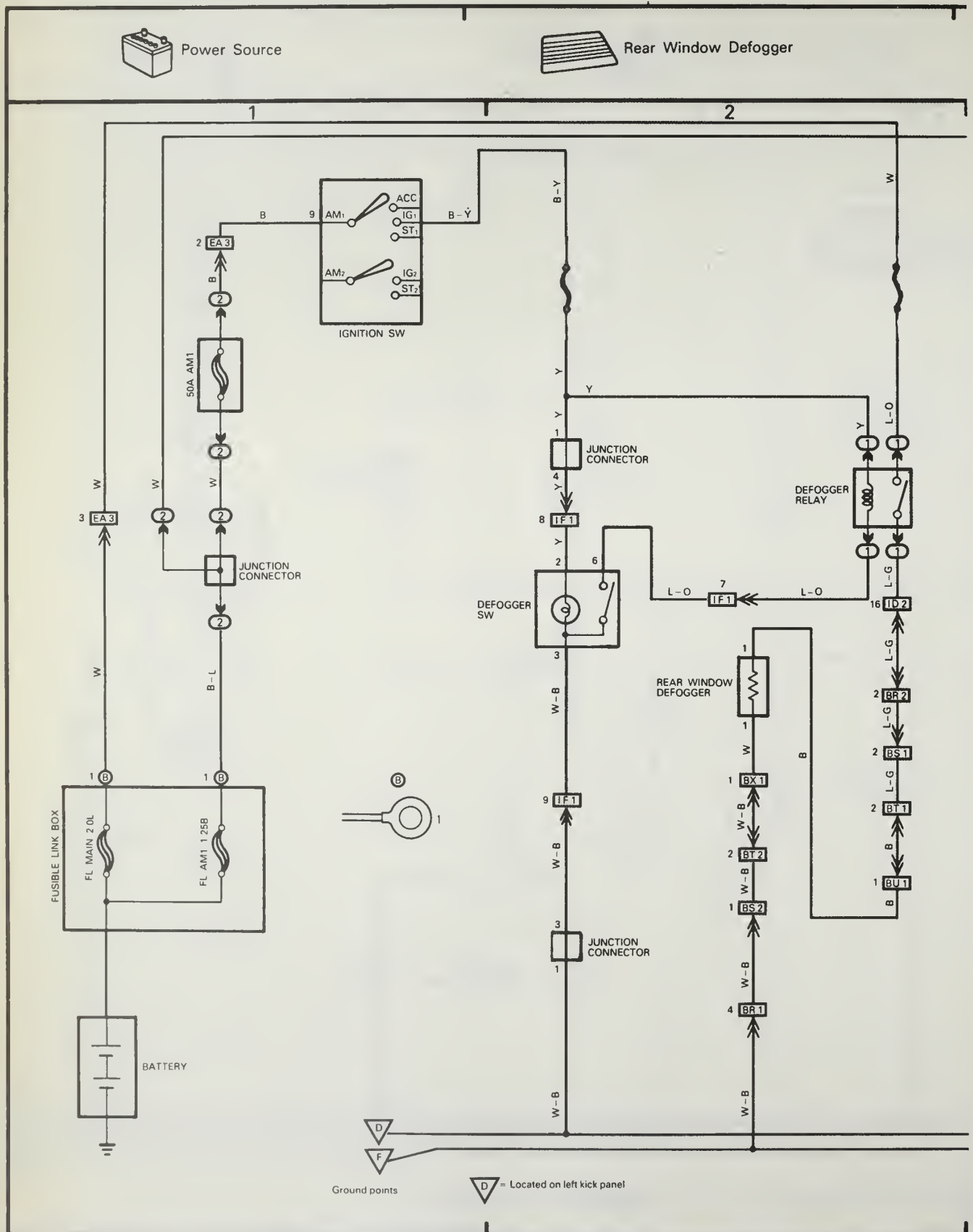
Wiring diagram — 1991 Land Cruiser

CHASSIS ELECTRICAL 6

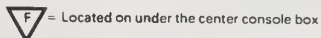
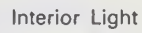


Wiring diagram — 1991 Land Cruiser

6 CHASSIS ELECTRICAL

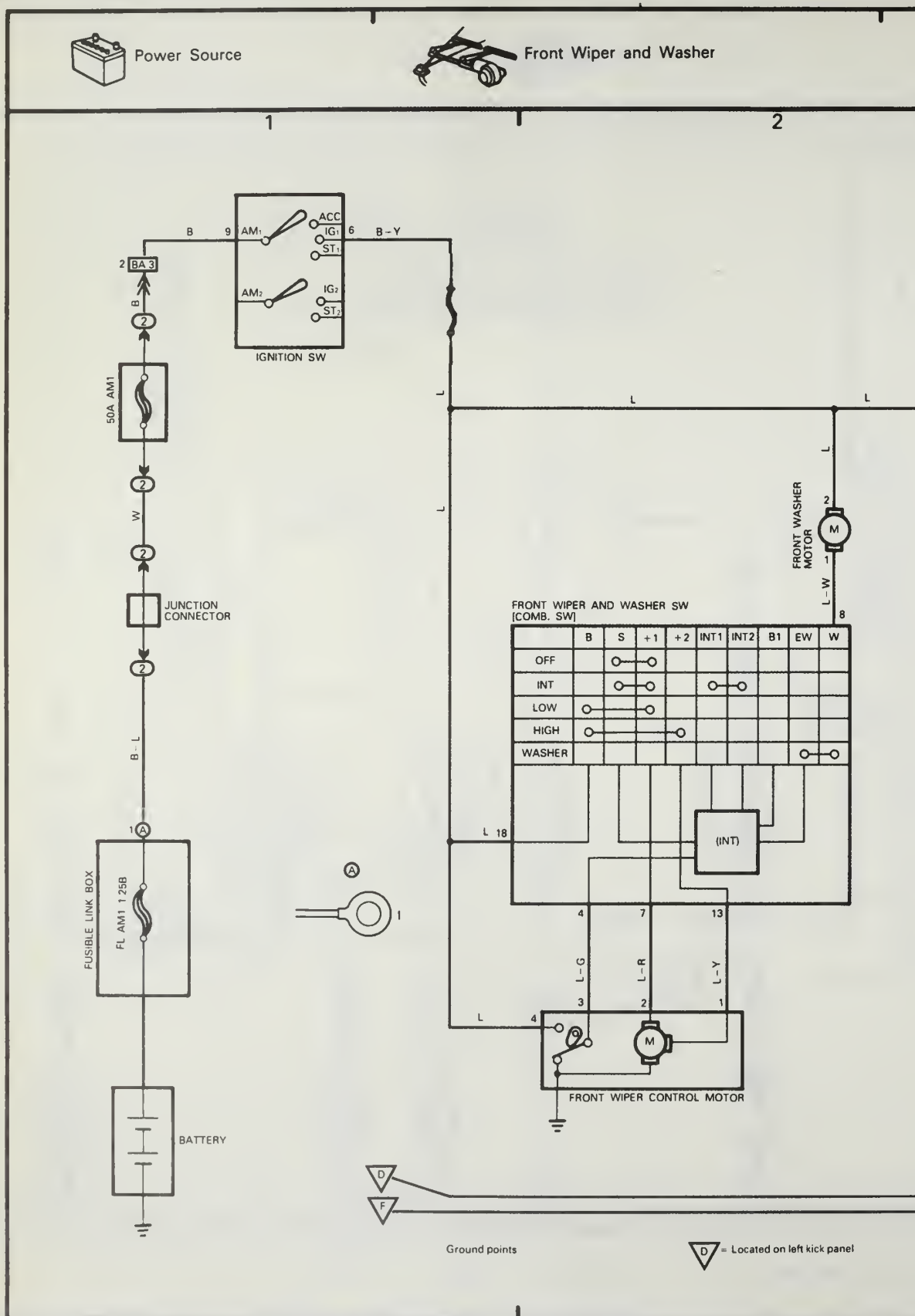


Wiring diagram — 1991 Land Cruiser



Wiring diagram — 1991 Land Cruiser

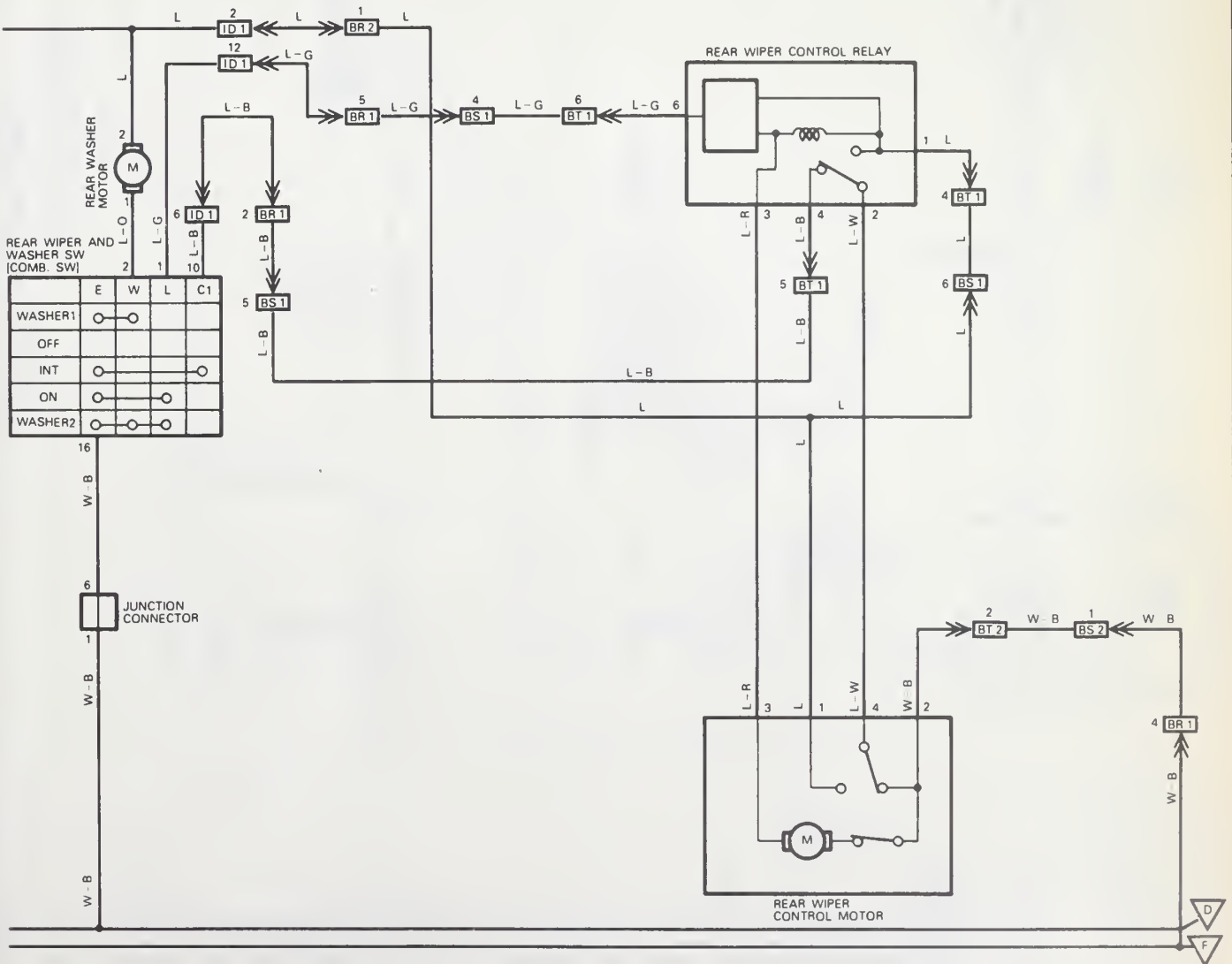
6 CHASSIS ELECTRICAL



Wiring diagram — 1991 Land Cruiser



Rear Wiper and Washer



Wiring diagram — 1991 Land Cruiser

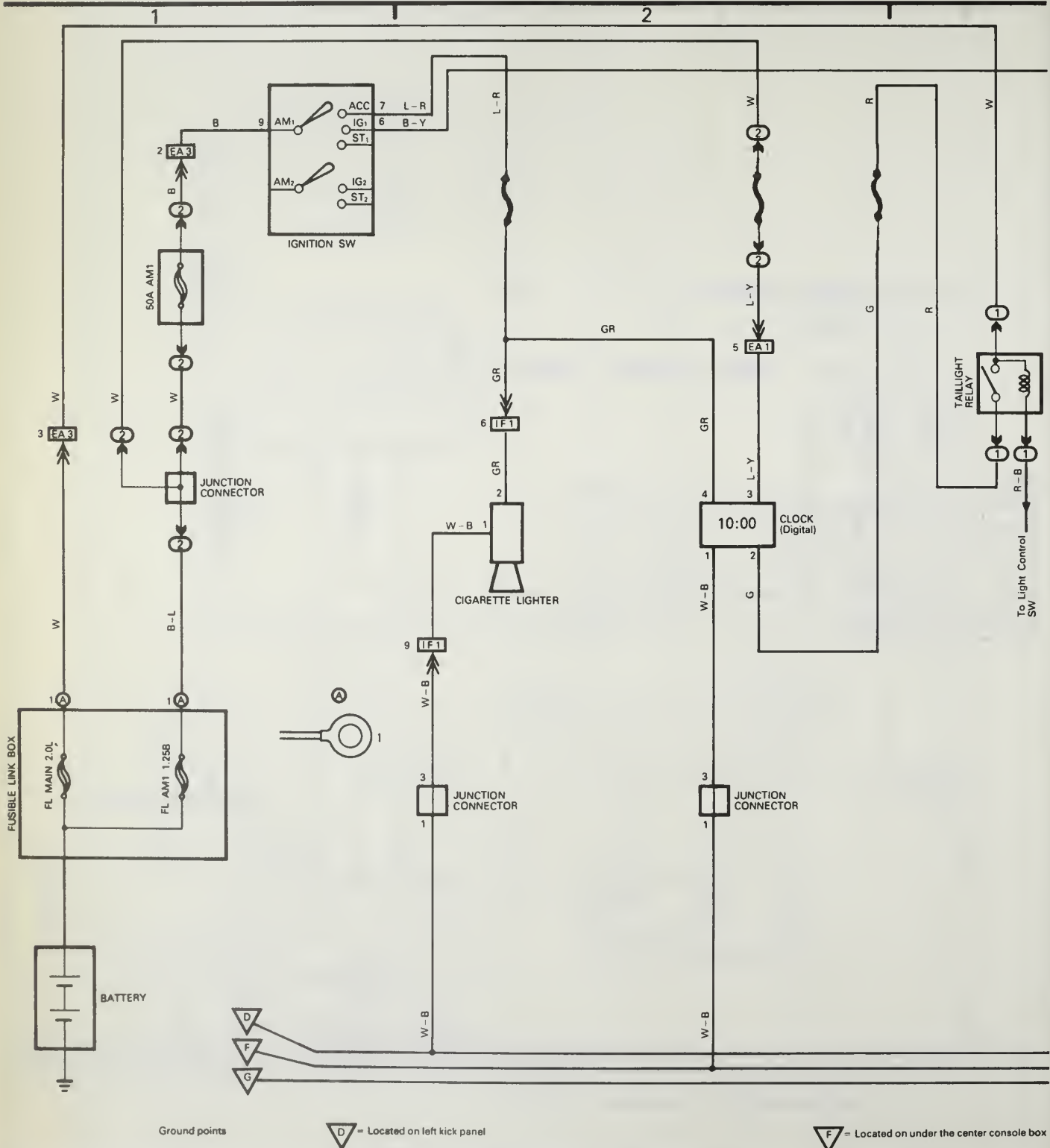
6 CHASSIS ELECTRICAL



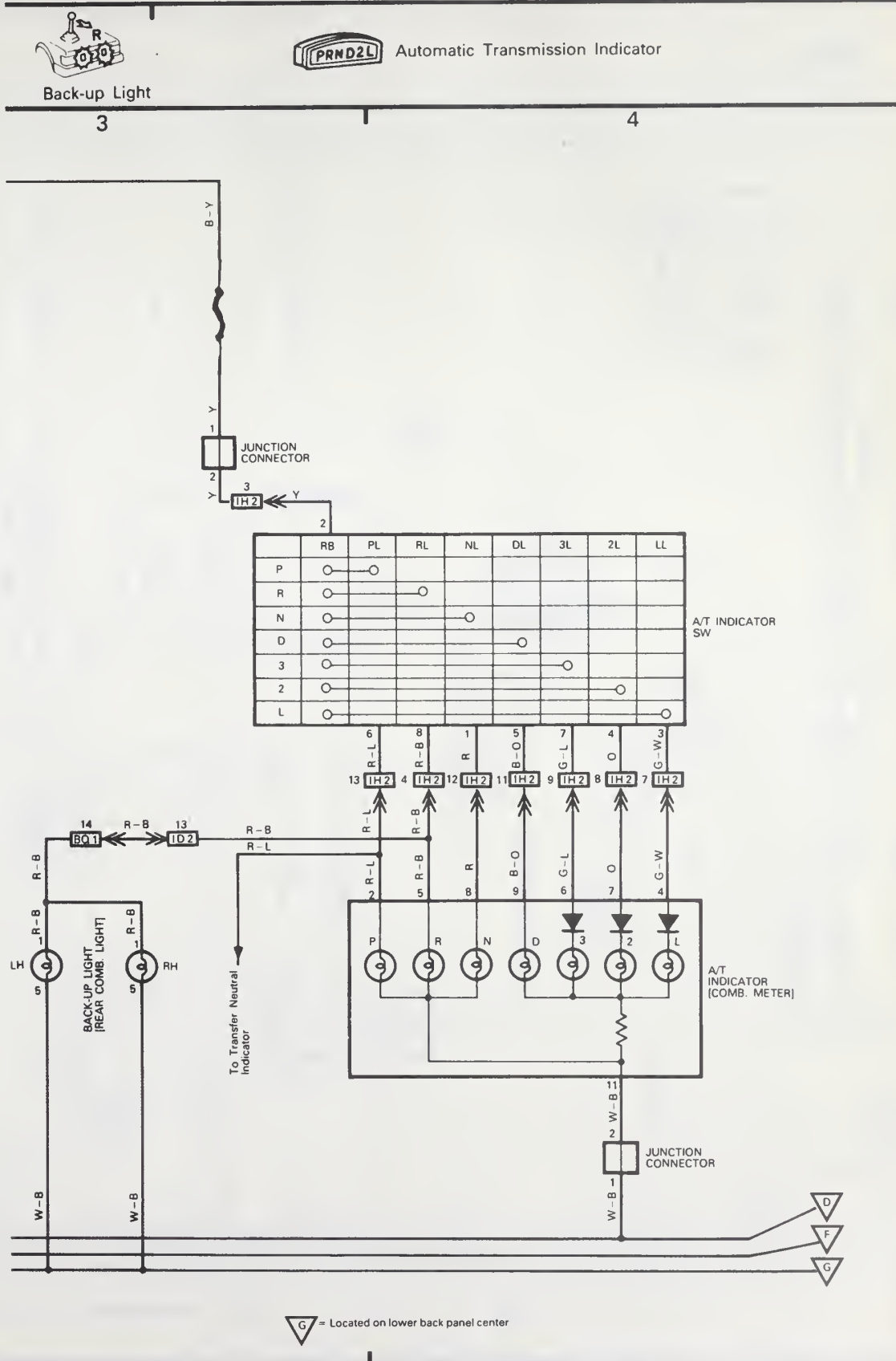
Power Source



Cigarette Lighter and Clock



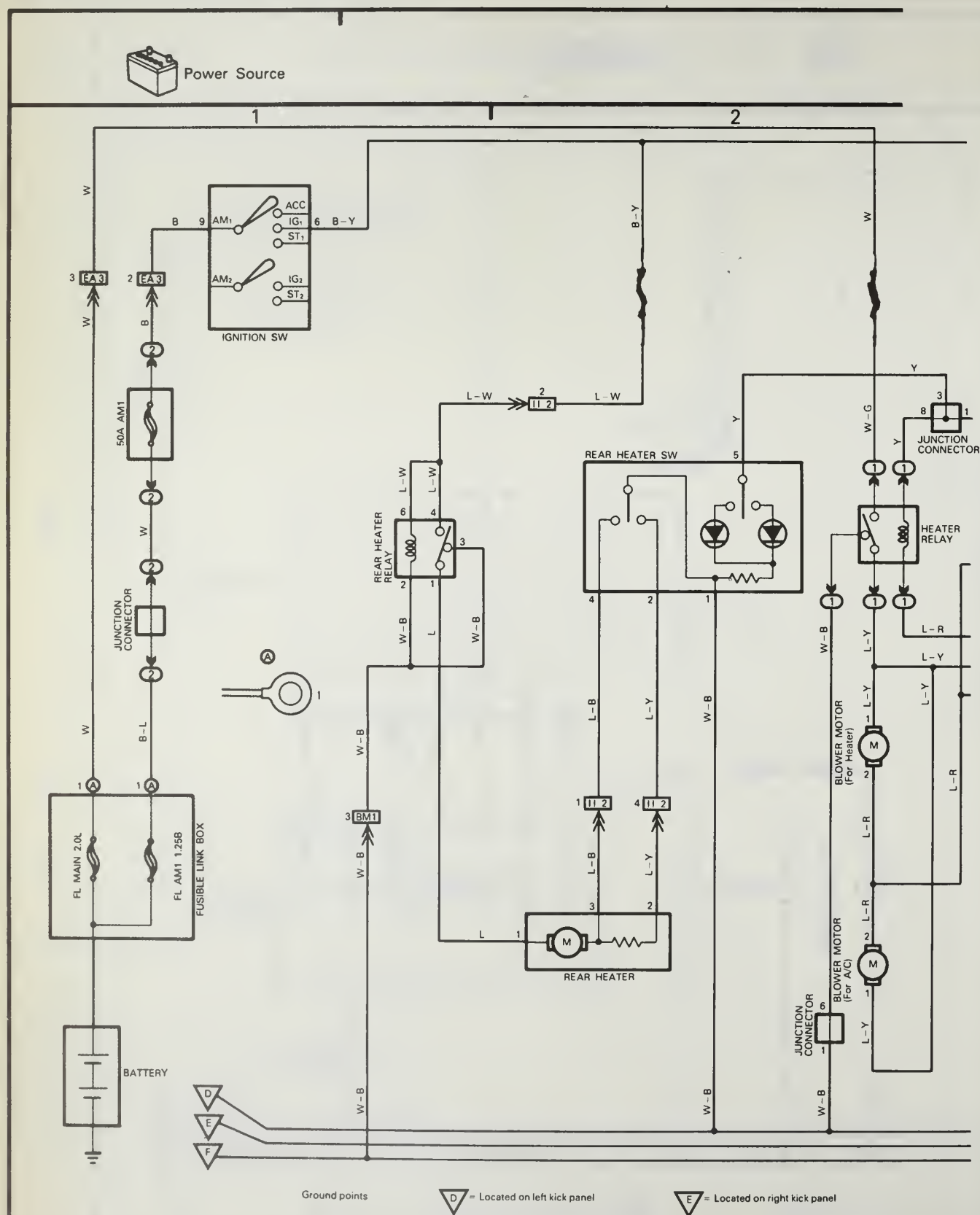
Wiring diagram — 1991 Land Cruiser



= Located on lower back panel center

Wiring diagram — 1991 Land Cruiser

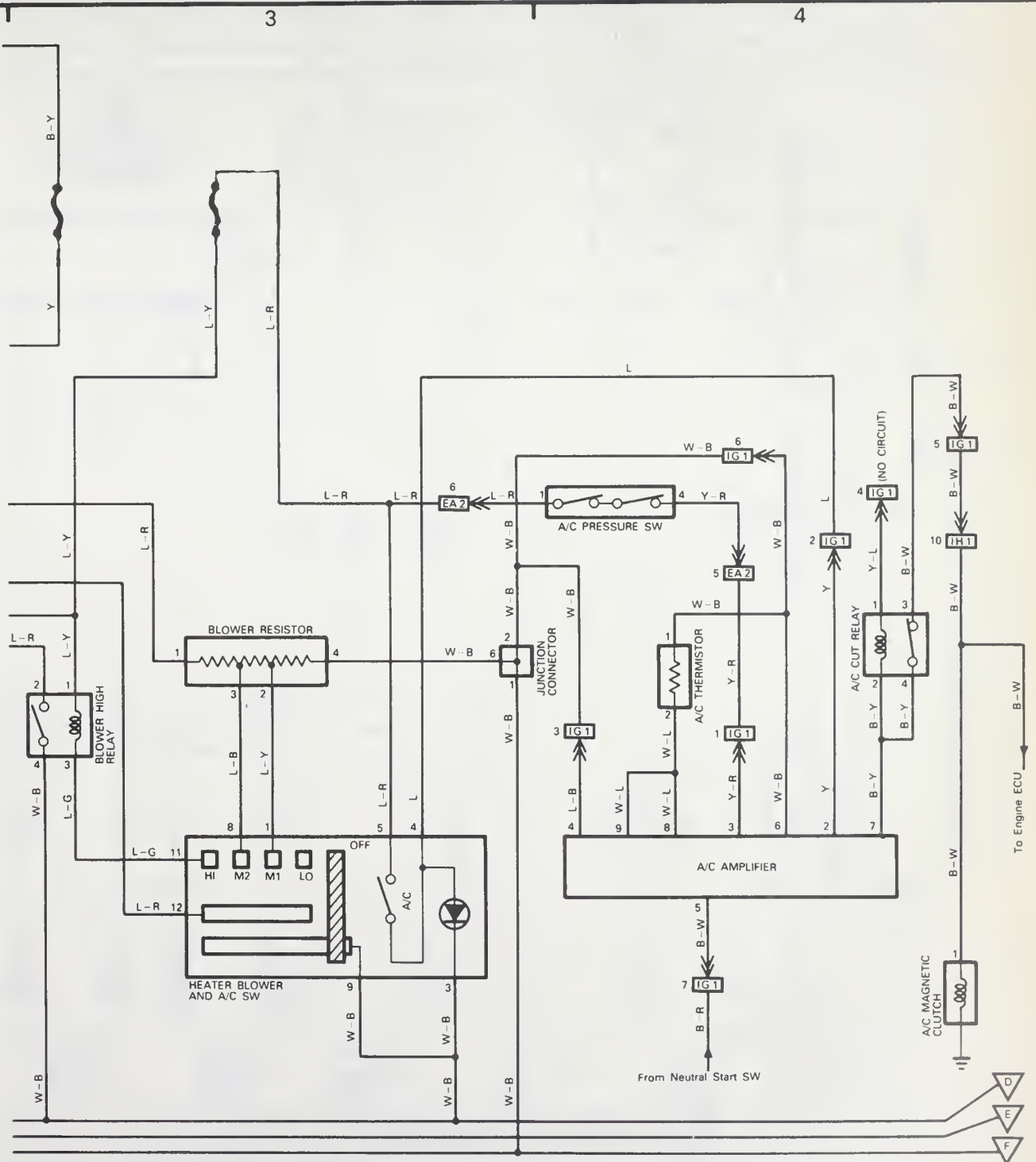
6 CHASSIS ELECTRICAL



Wiring diagram -- 1991 Land Cruiser

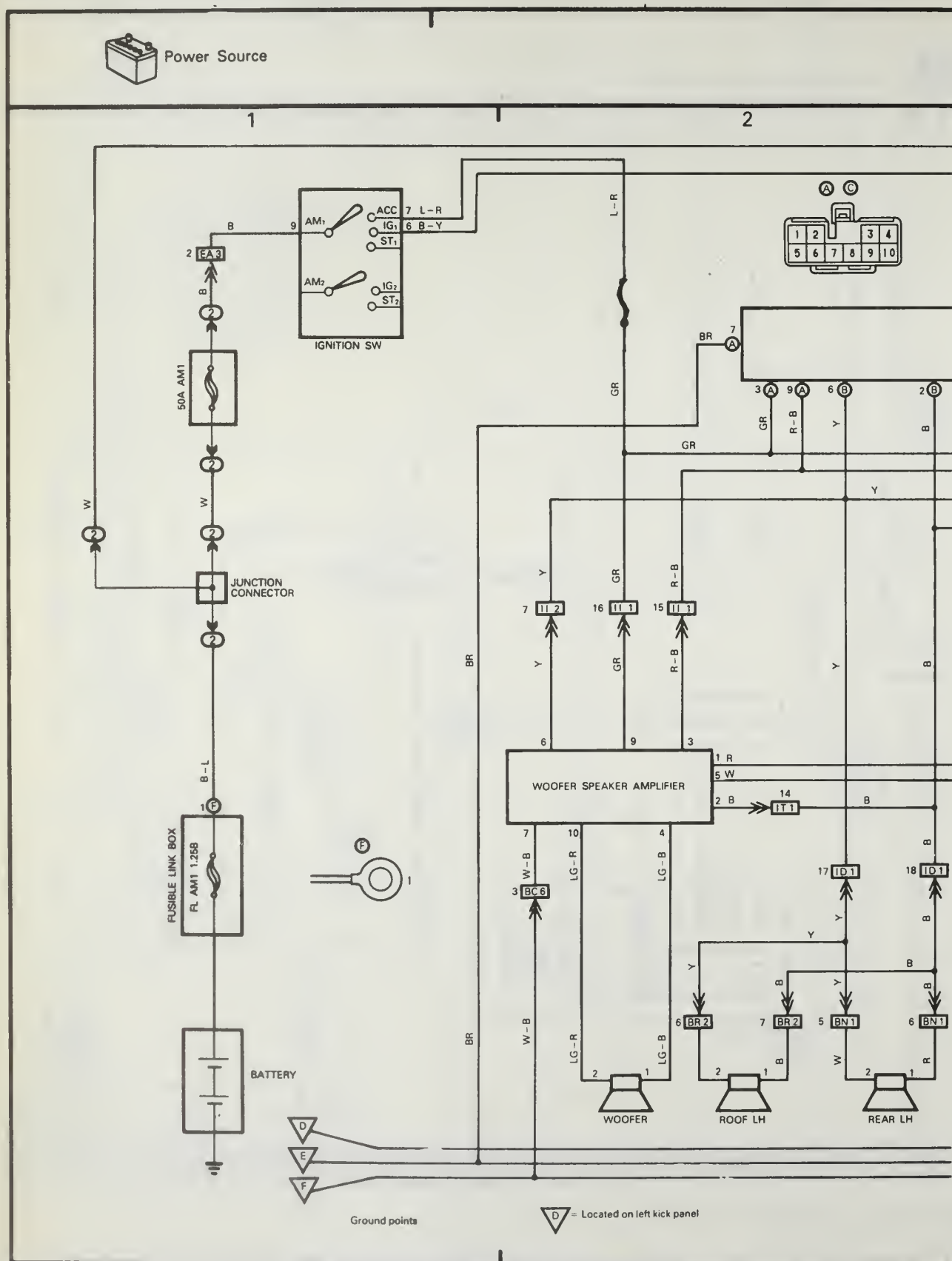


Air Conditioner, Cooler and Heater



Wiring diagram – 1991 Land Cruiser

6 CHASSIS ELECTRICAL

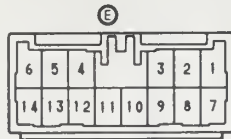
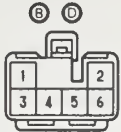


Wiring diagram — 1991 Land Cruiser

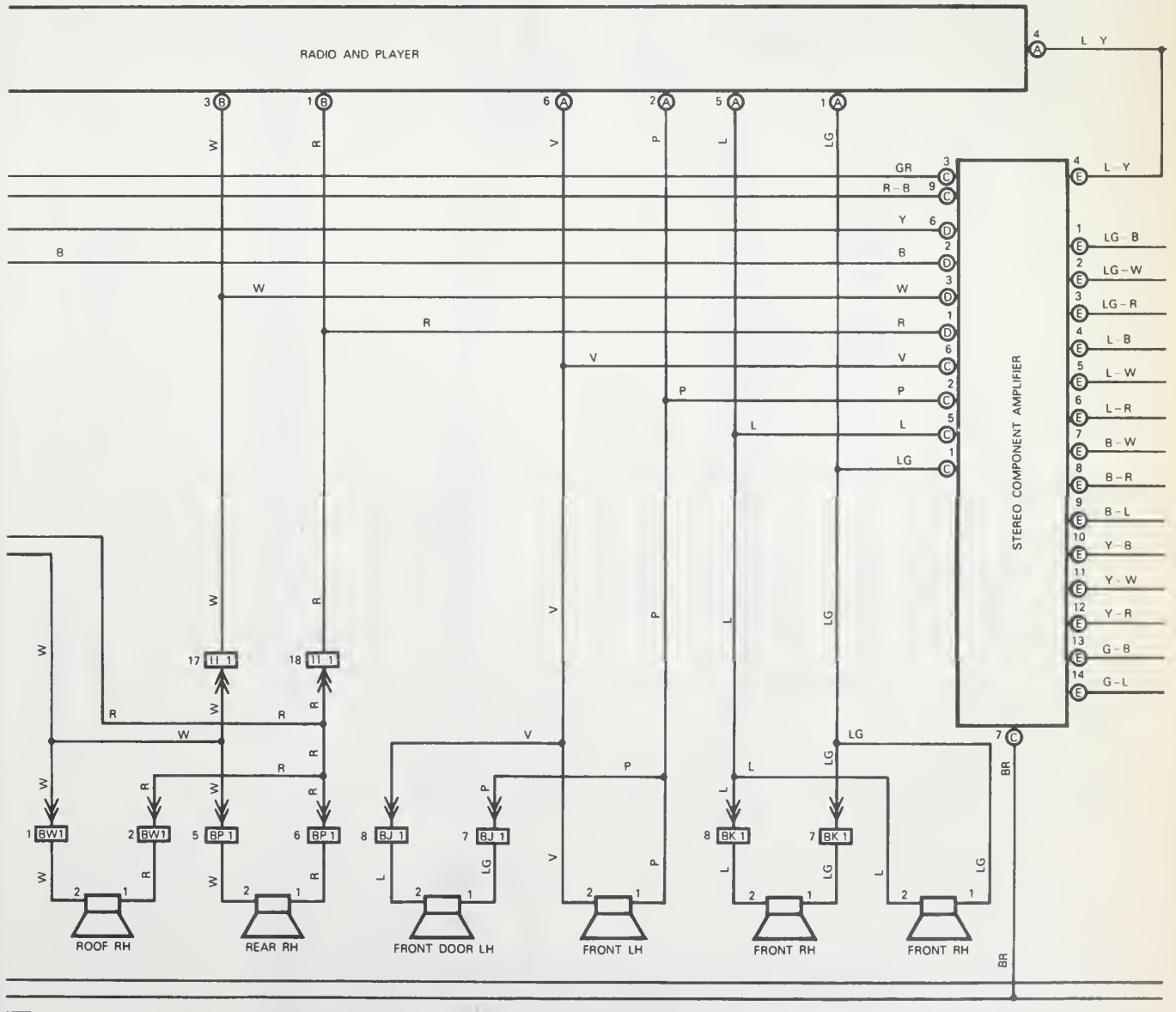
CHASSIS ELECTRICAL 6



Radio and Player



RADIO AND PLAYER

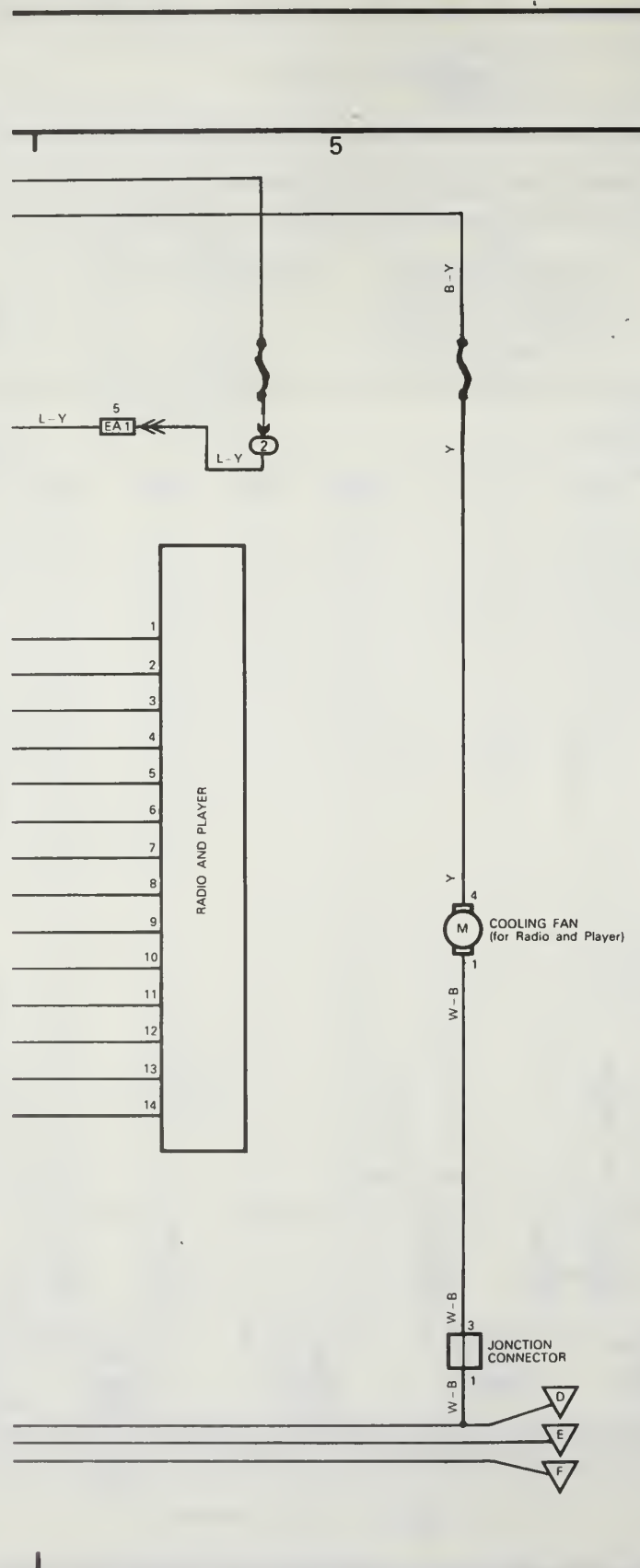


= Located on right kick panel

= Located on under the center console box

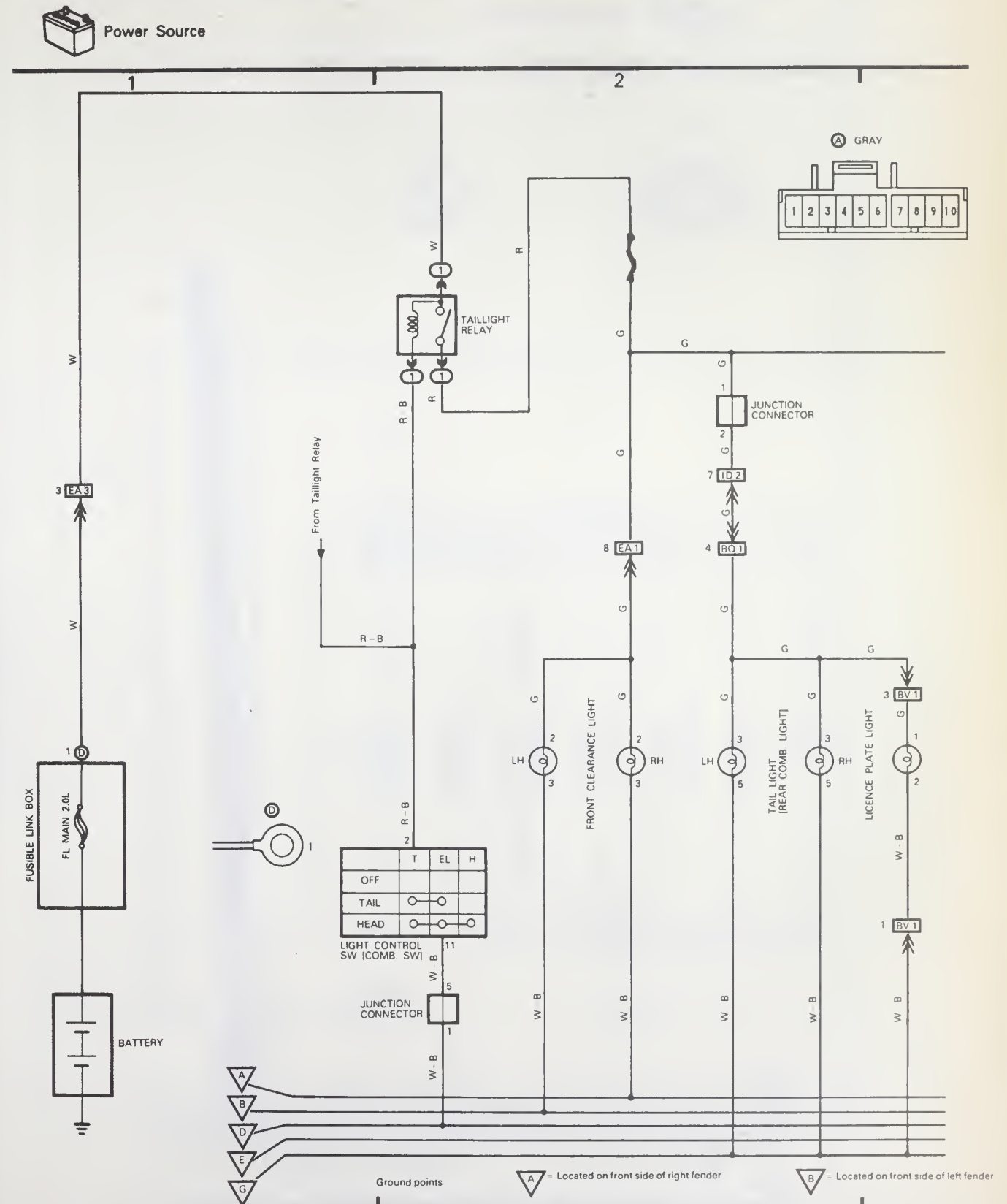
Wiring diagram — 1991 Land Cruiser

6 CHASSIS ELECTRICAL



Wiring diagram — 1991 Land Cruiser

CHASSIS ELECTRICAL 6



Wiring diagram — 1991 Land Cruiser

6 CHASSIS ELECTRICAL



Taillight and Illumination

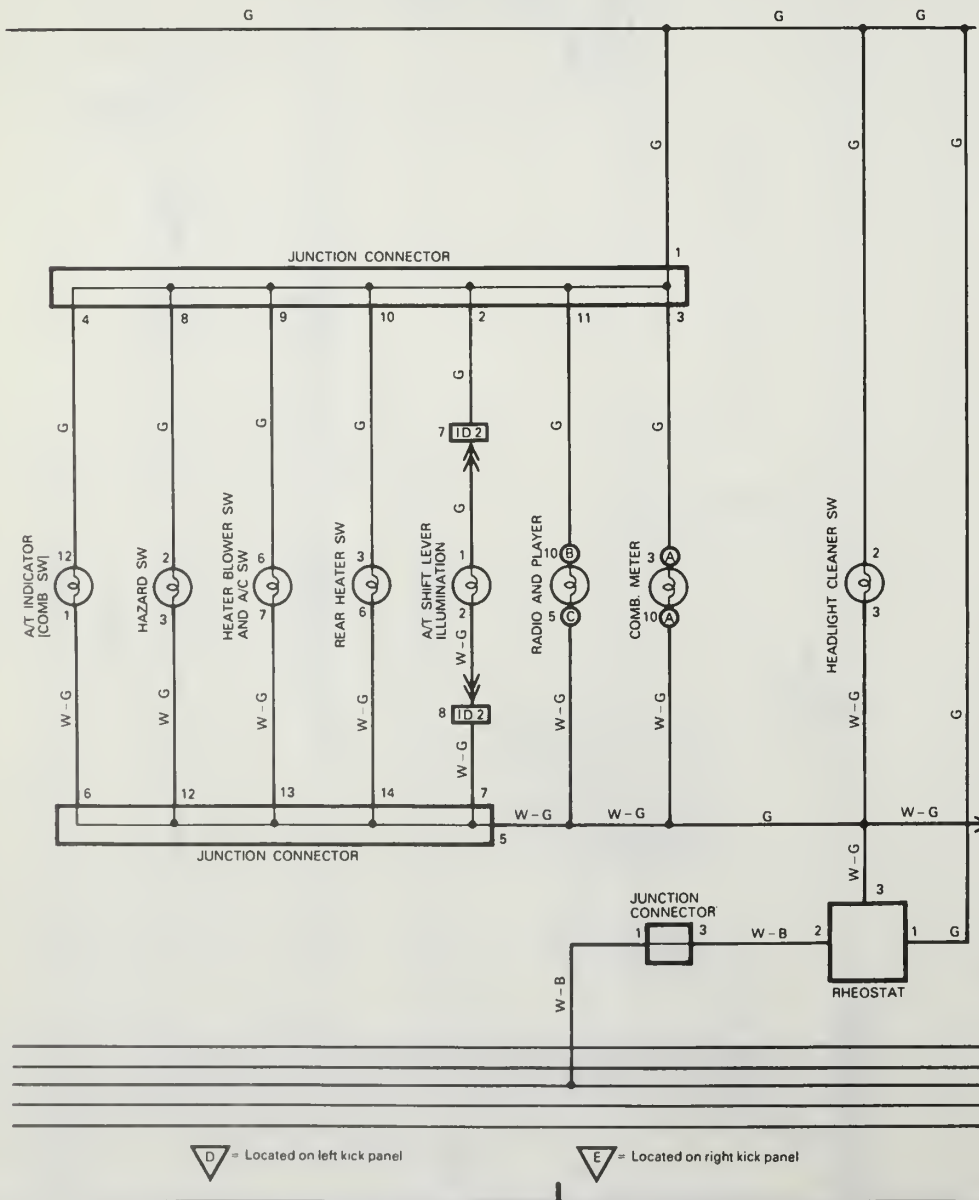
3

4

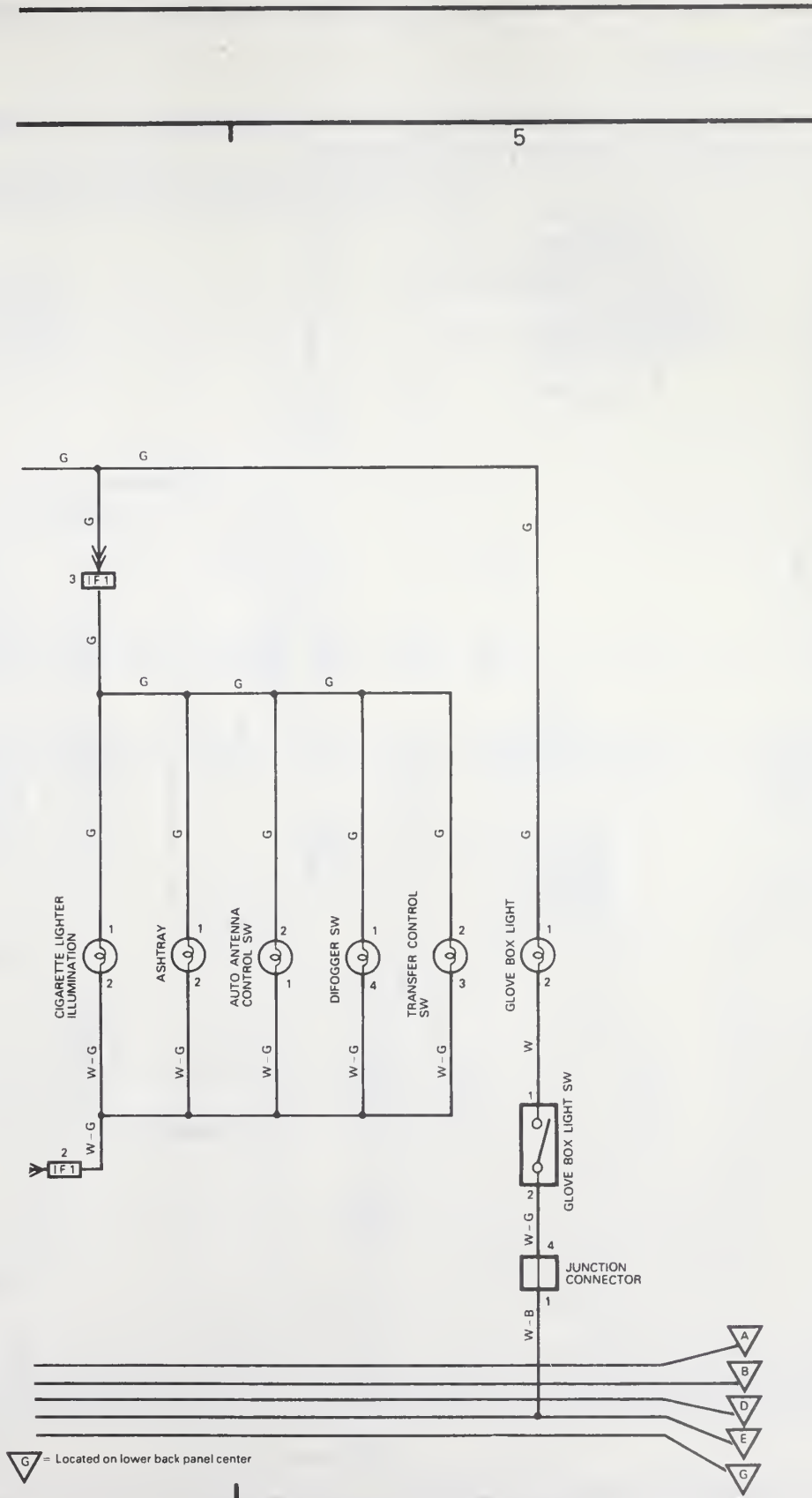
(B)



(C)

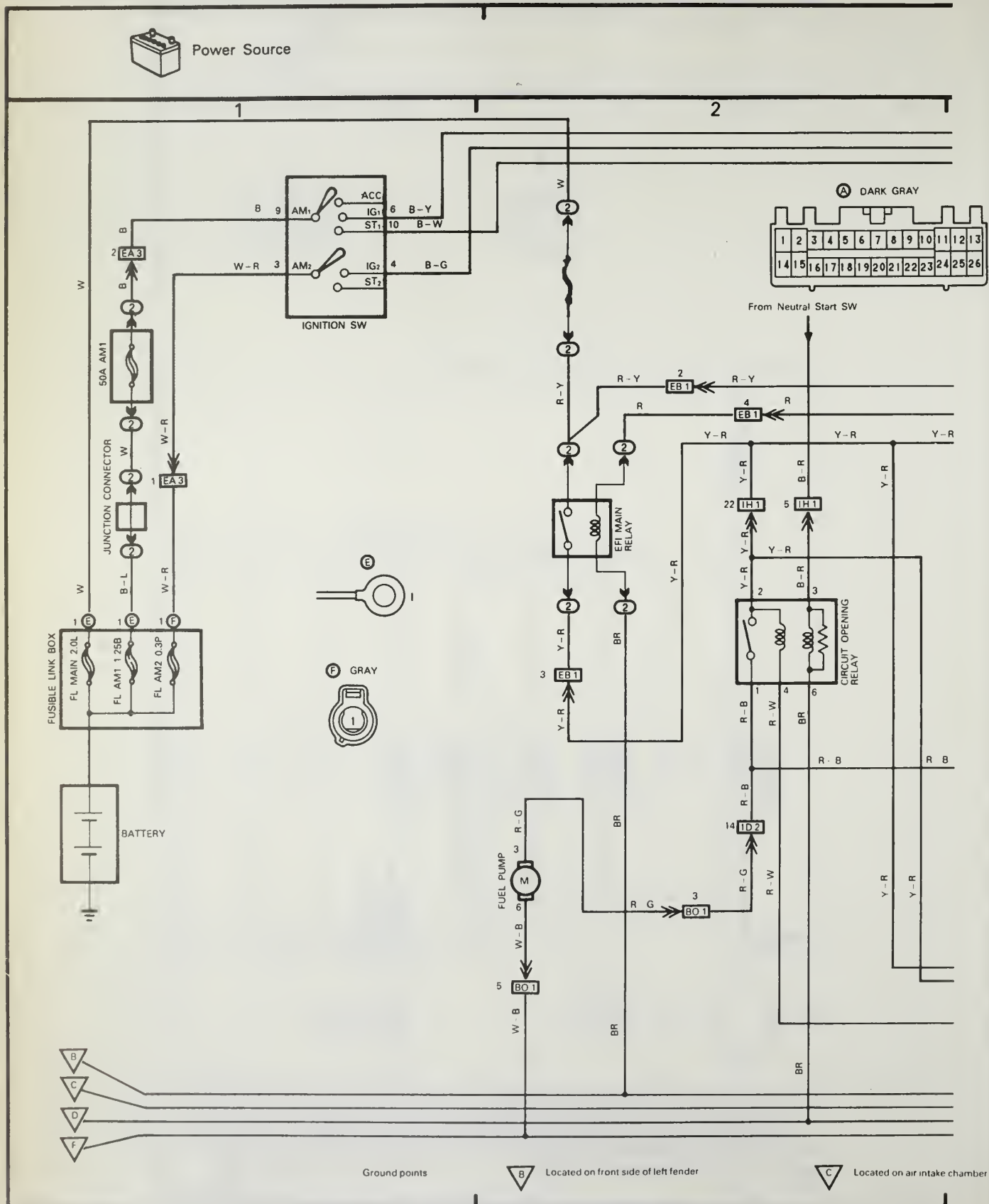


Wiring diagram — 1991 Land Cruiser



Wiring diagram — 1991 Land Cruiser

6 CHASSIS ELECTRICAL





6-301

6 CHASSIS ELECTRICAL



Engine Control

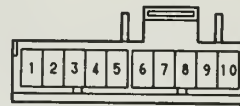
5

6

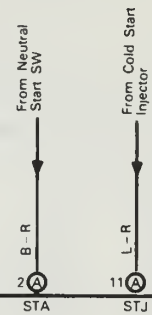
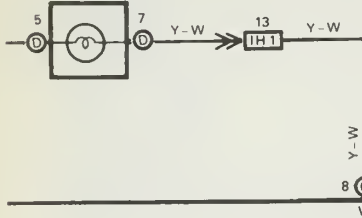
Ⓒ DARK GRAY



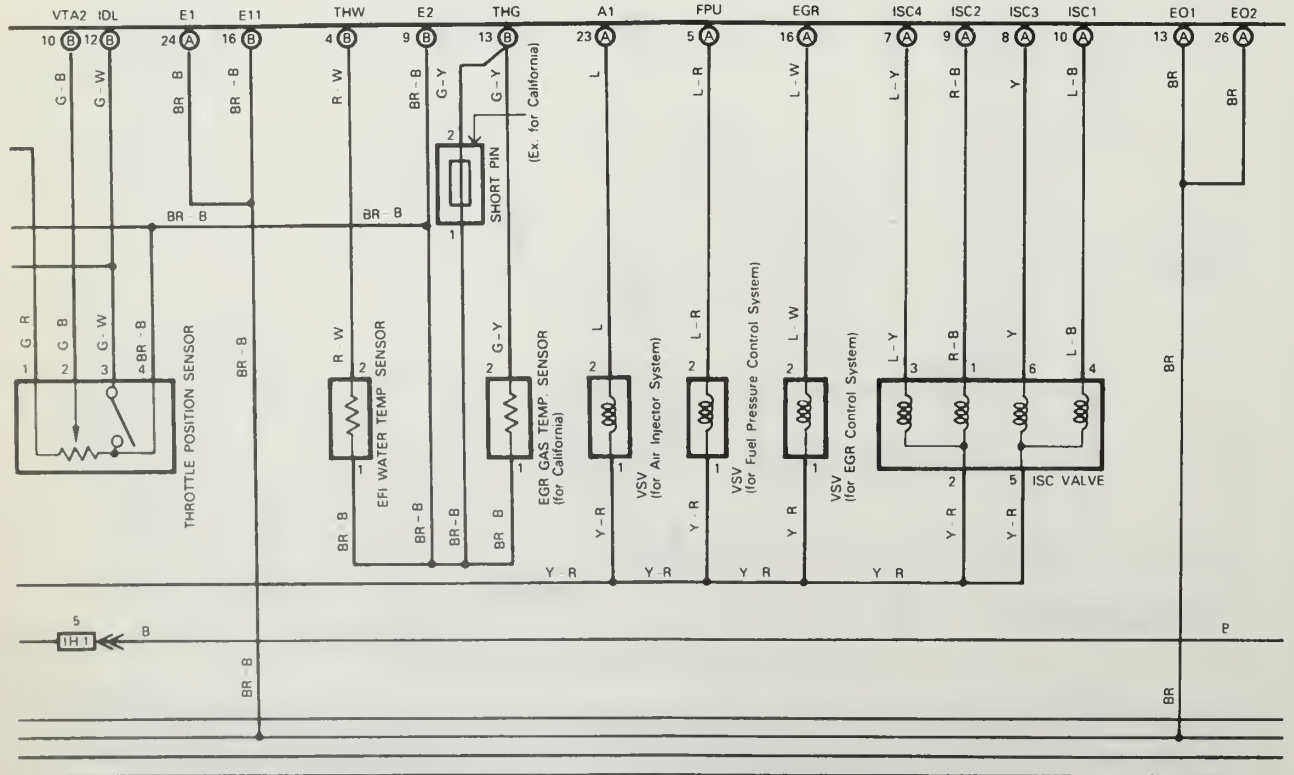
Ⓓ BROWN



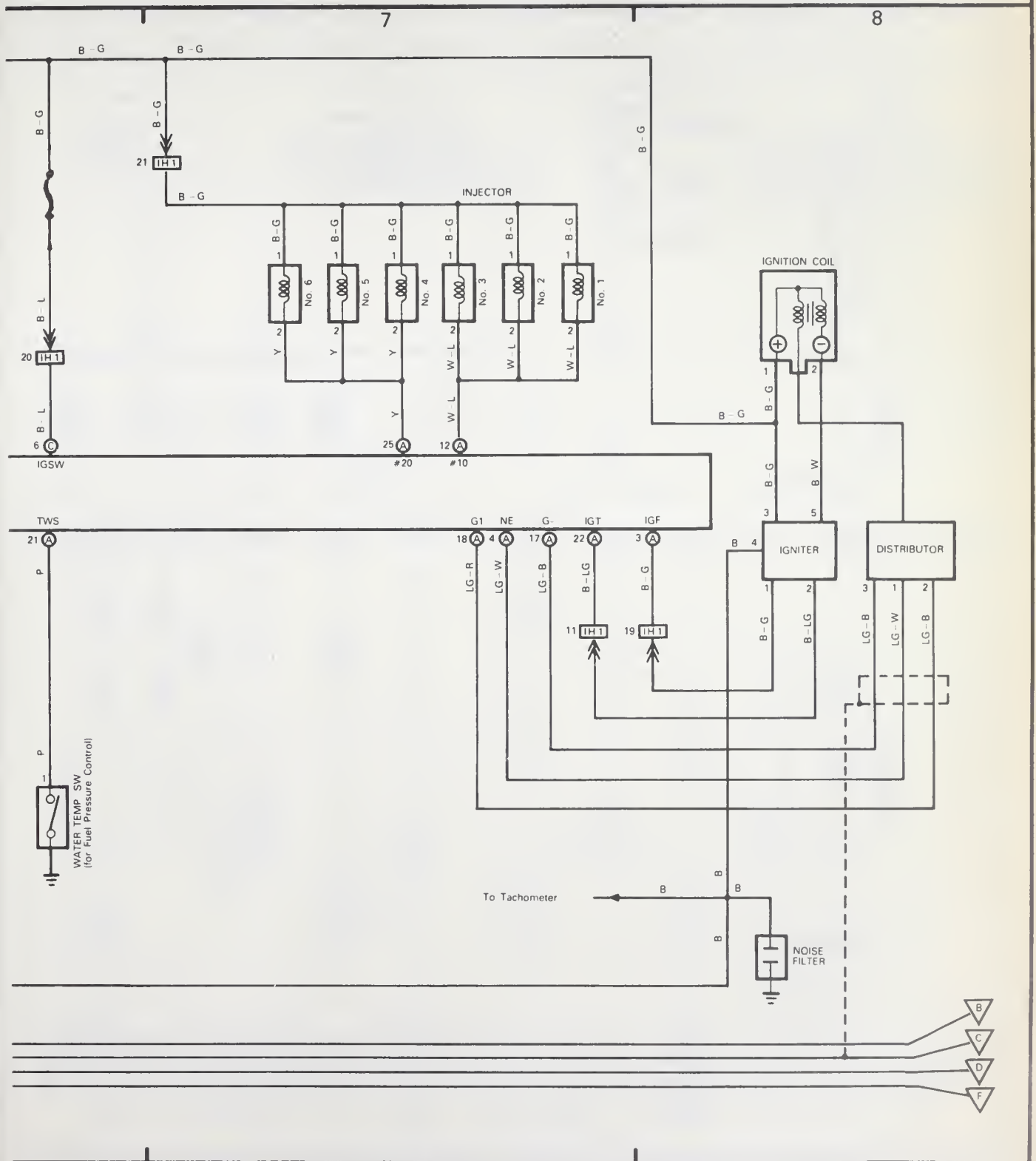
CHECK ENGINE
(COMB. METER)



ENGINE ECU

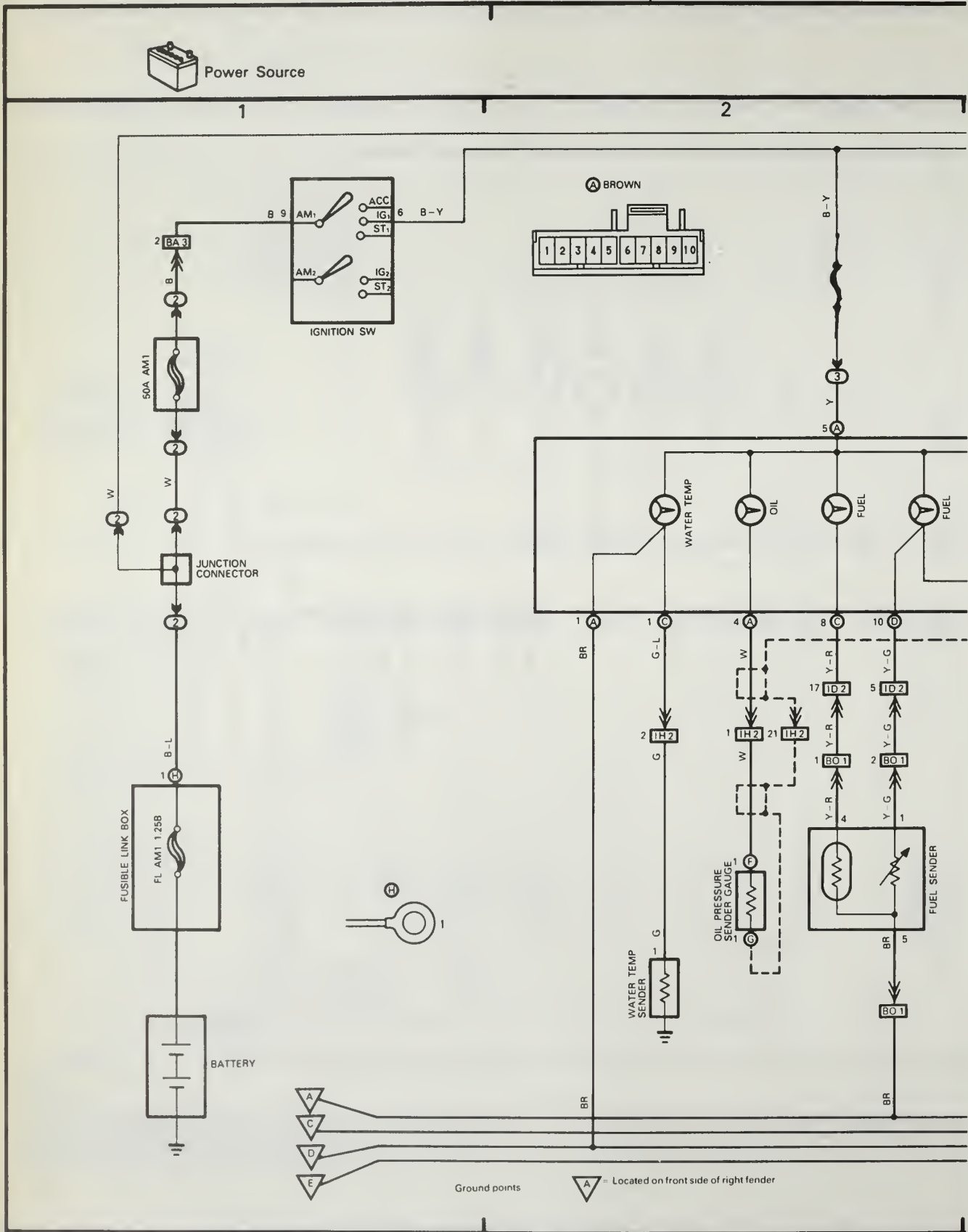


Wiring diagram – 1991 Land Cruiser

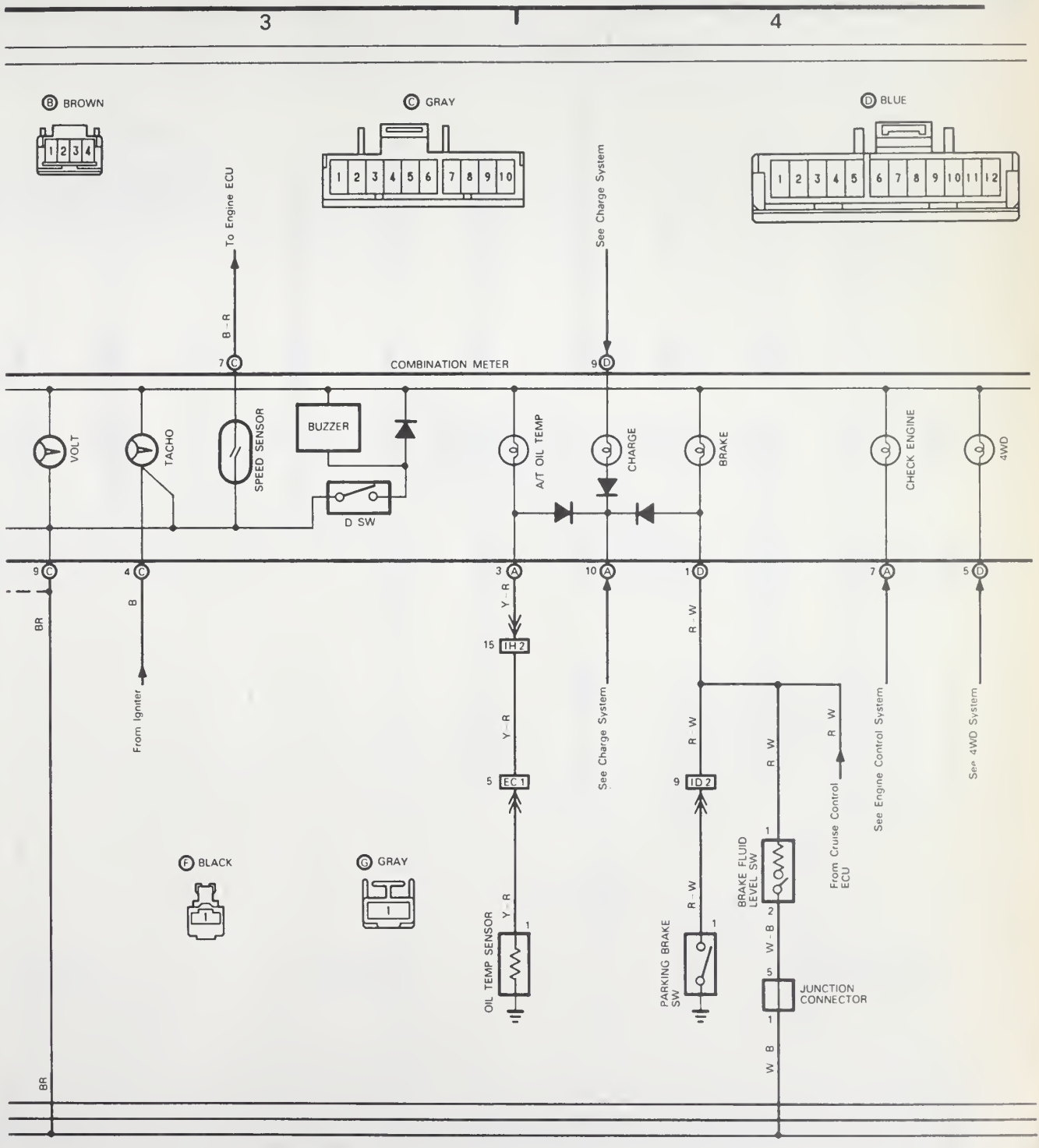


Wiring diagram - 1991 Land Cruiser

6 CHASSIS ELECTRICAL



Wiring diagram – 1991 Land Cruiser

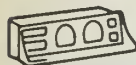


C Located on air intake chamber

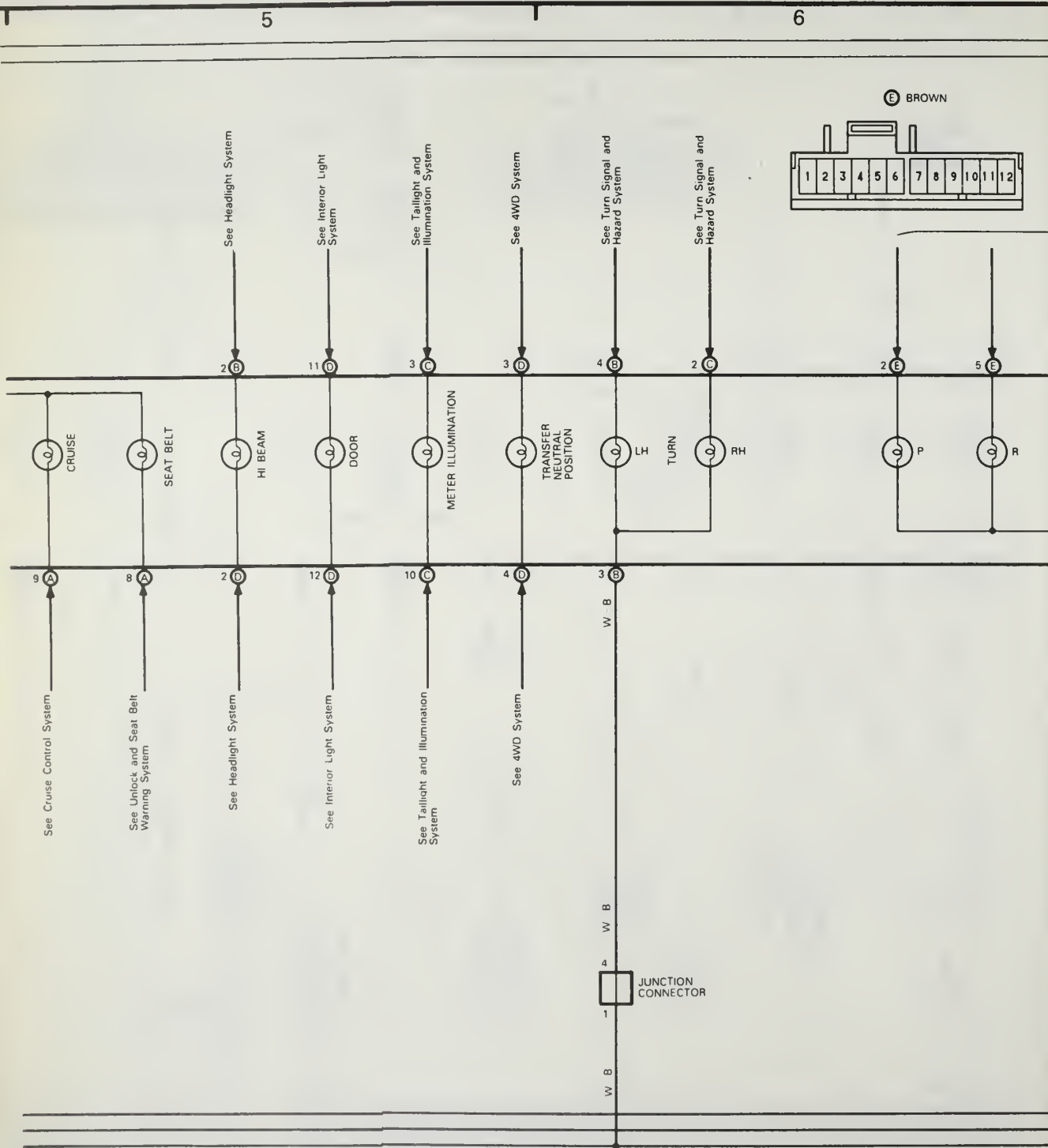
D Located on left kick panel

Wiring diagram – 1991 Land Cruiser

6 CHASSIS ELECTRICAL

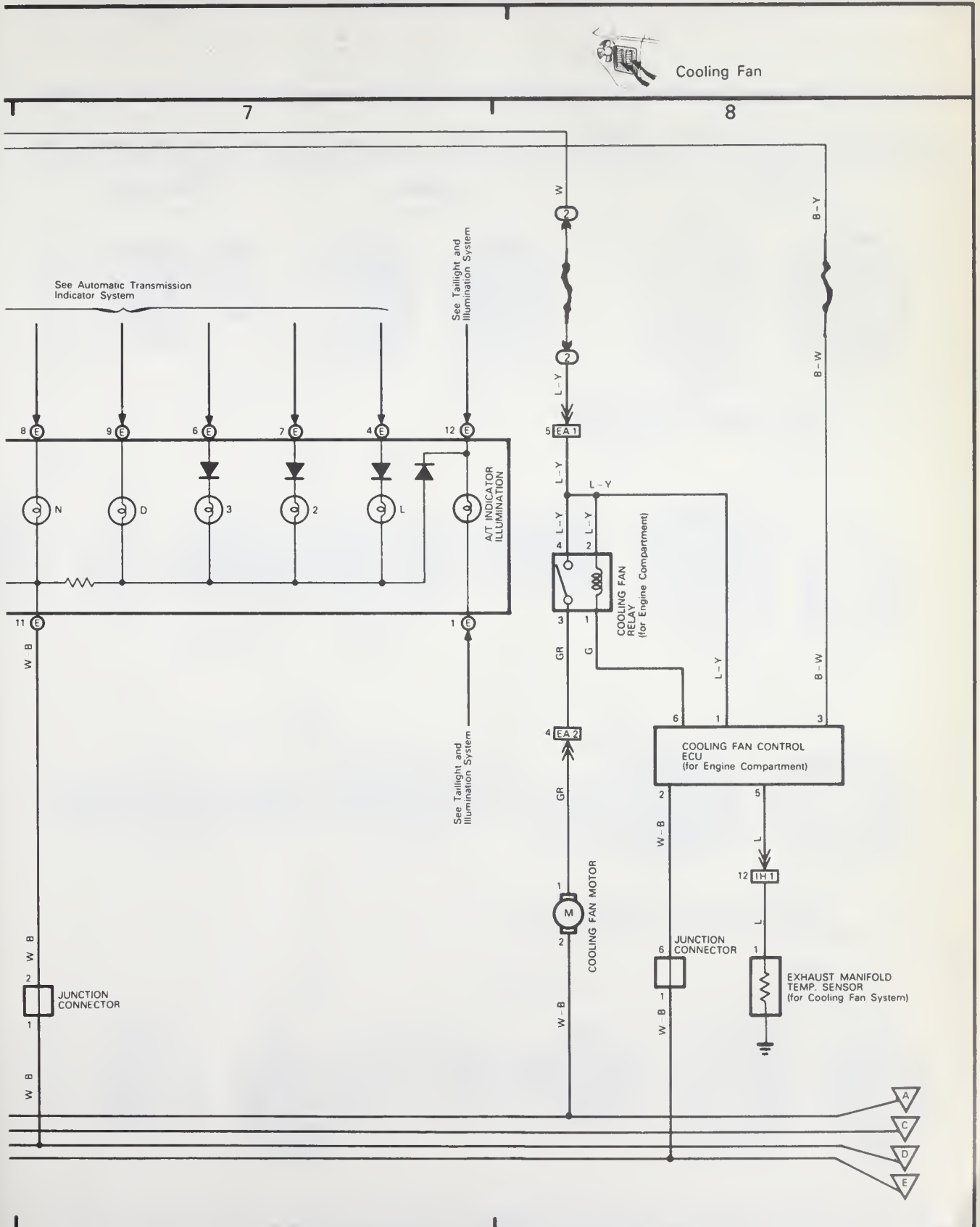


Combination Meter



E Located on right kick panel

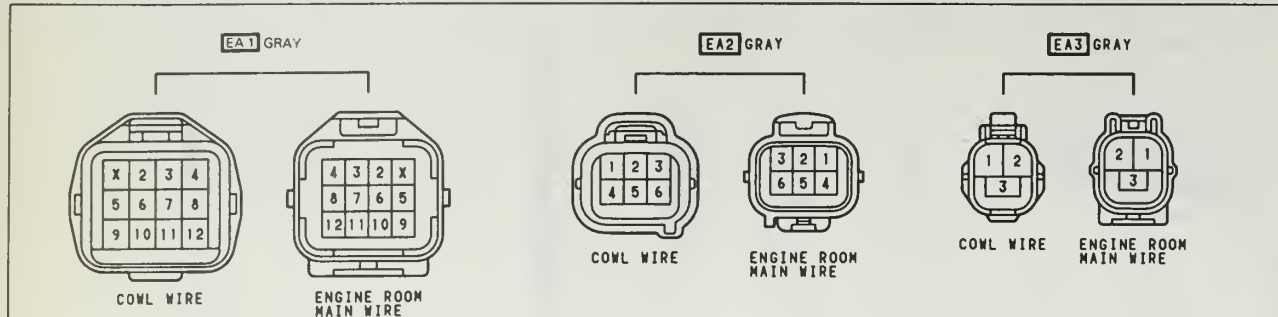
Wiring diagram — 1991 Land Cruiser



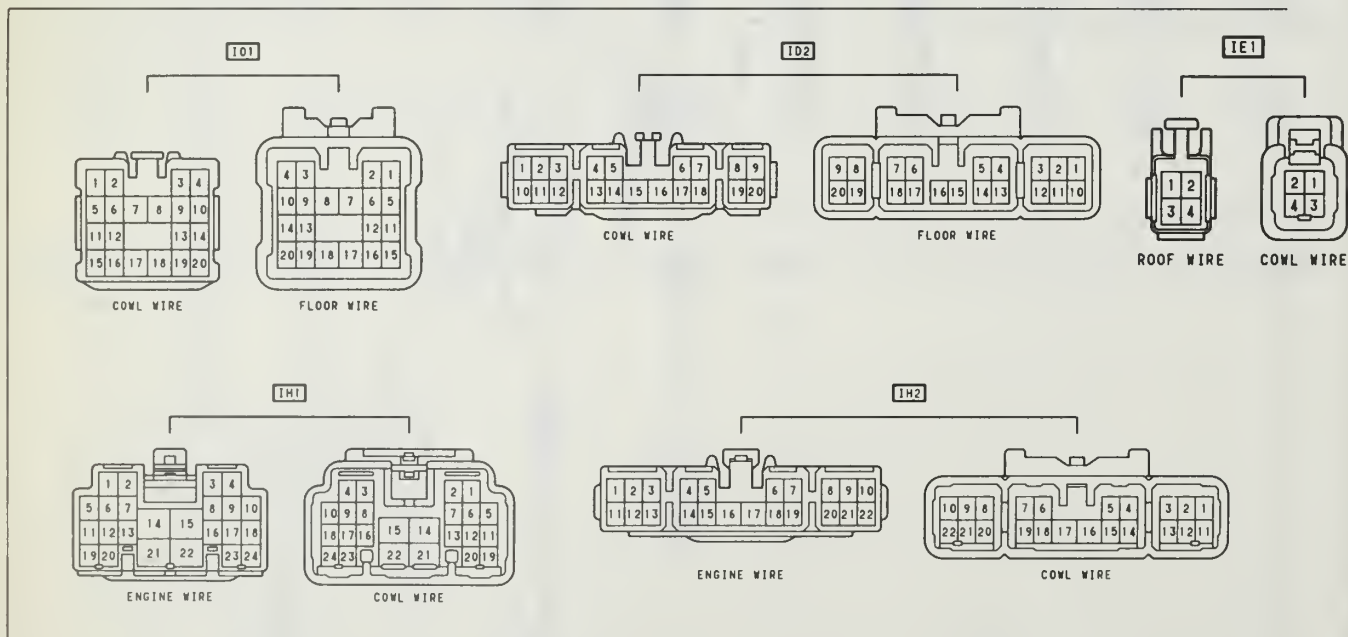
Wiring diagram — 1991 Land Cruiser

6 CHASSIS ELECTRICAL

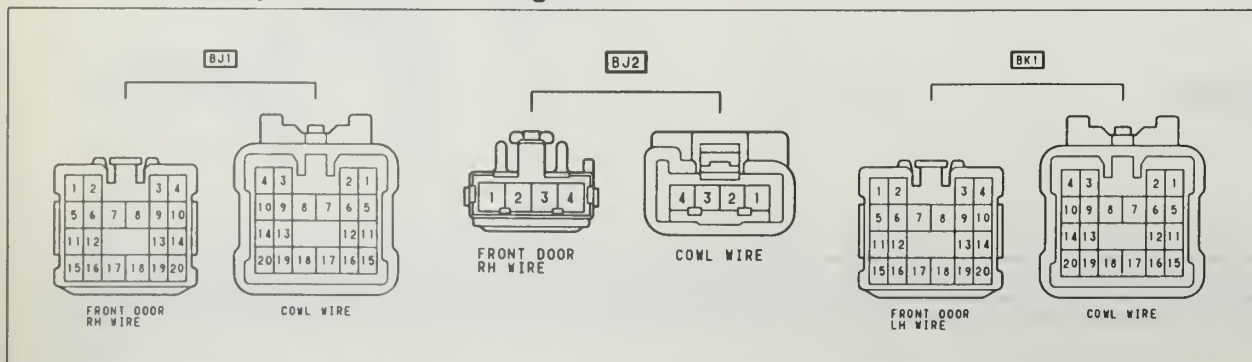
Connector Joining Wire Harness and Wire Harness Engine Compartment area



Instrument Panel area



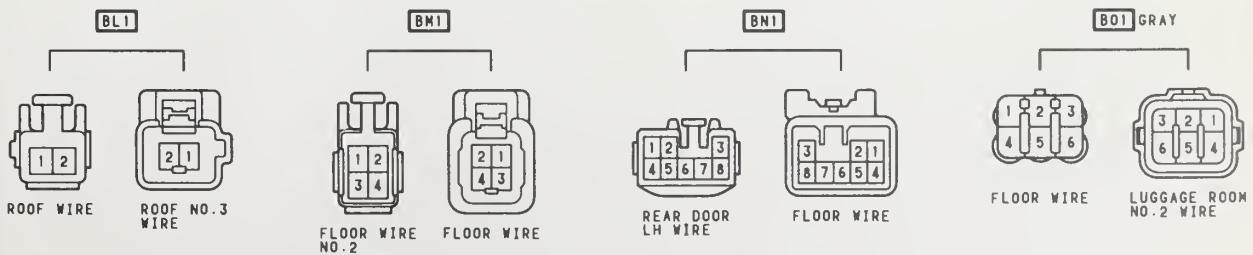
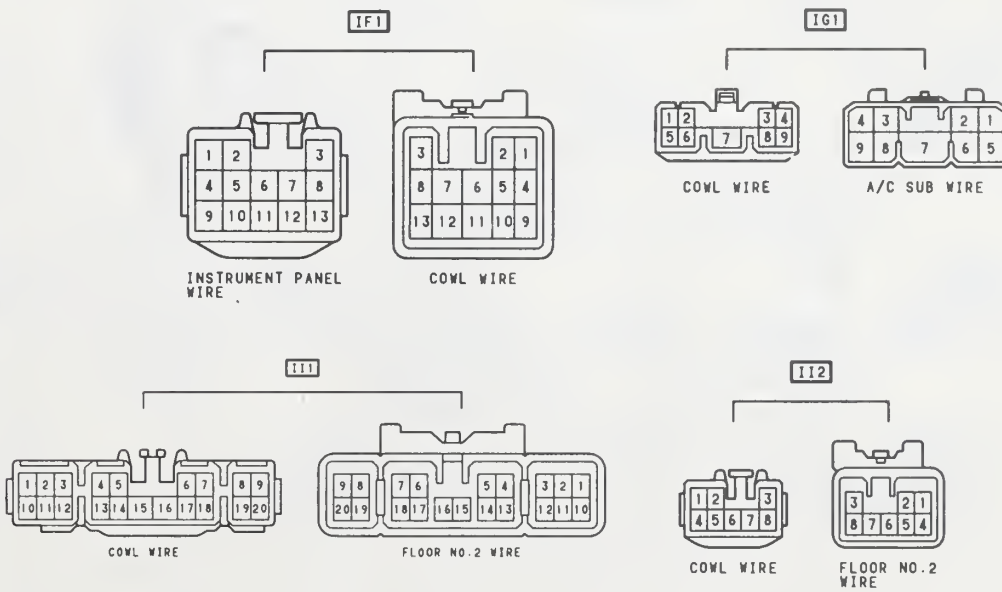
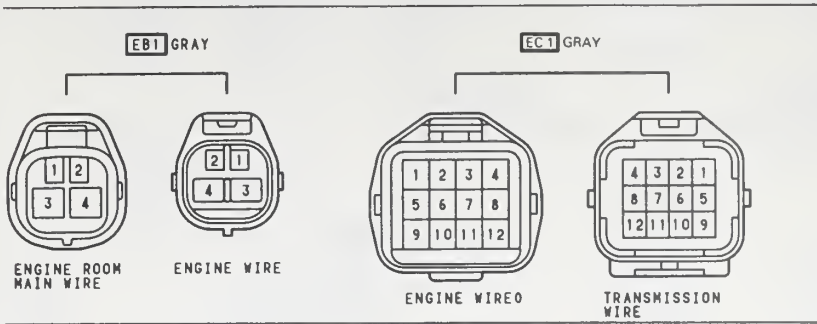
Body and Surrounding area



Wiring diagram — 1991 Land Cruiser

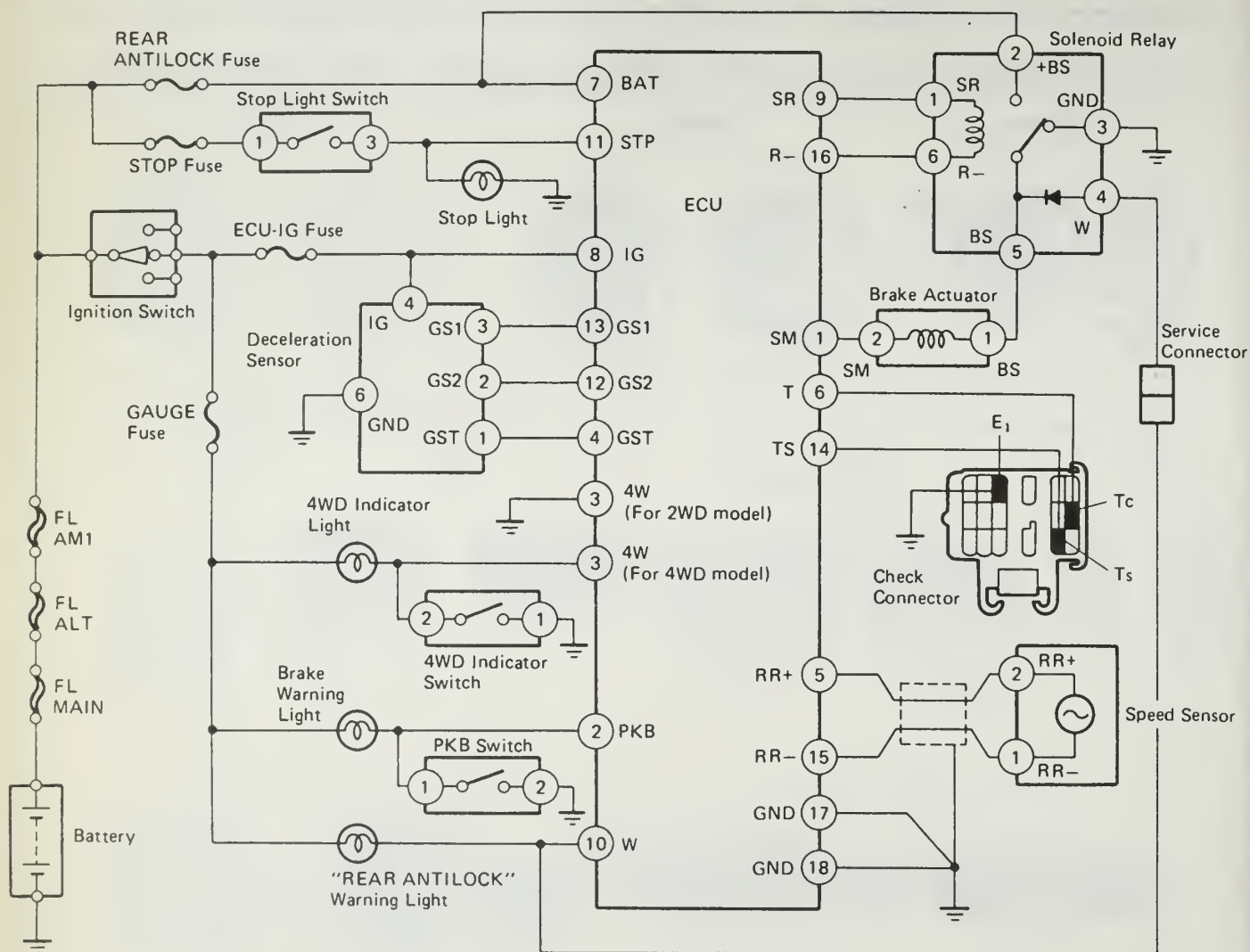
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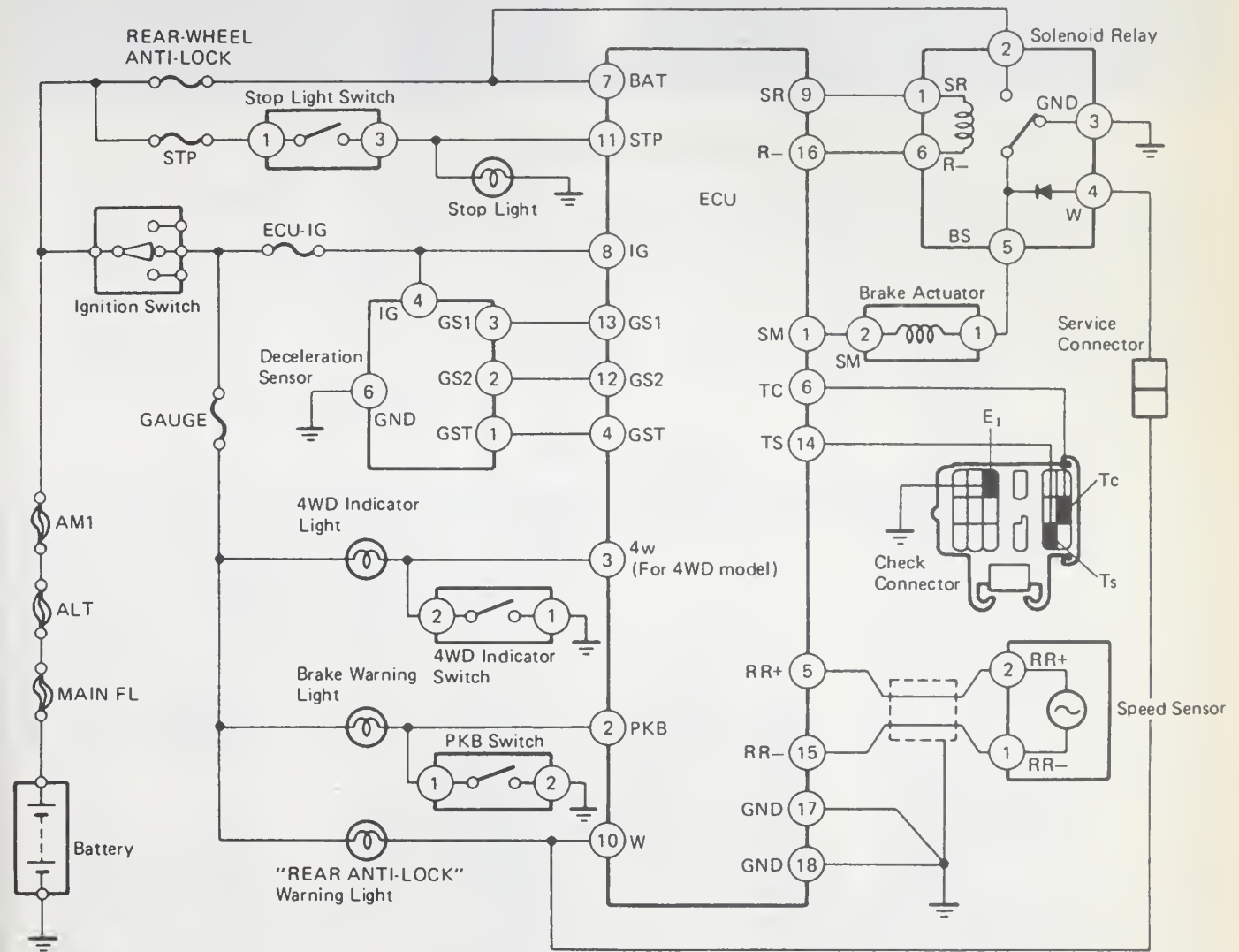


Wiring diagram – 1991 Land Cruiser

6 CHASSIS ELECTRICAL

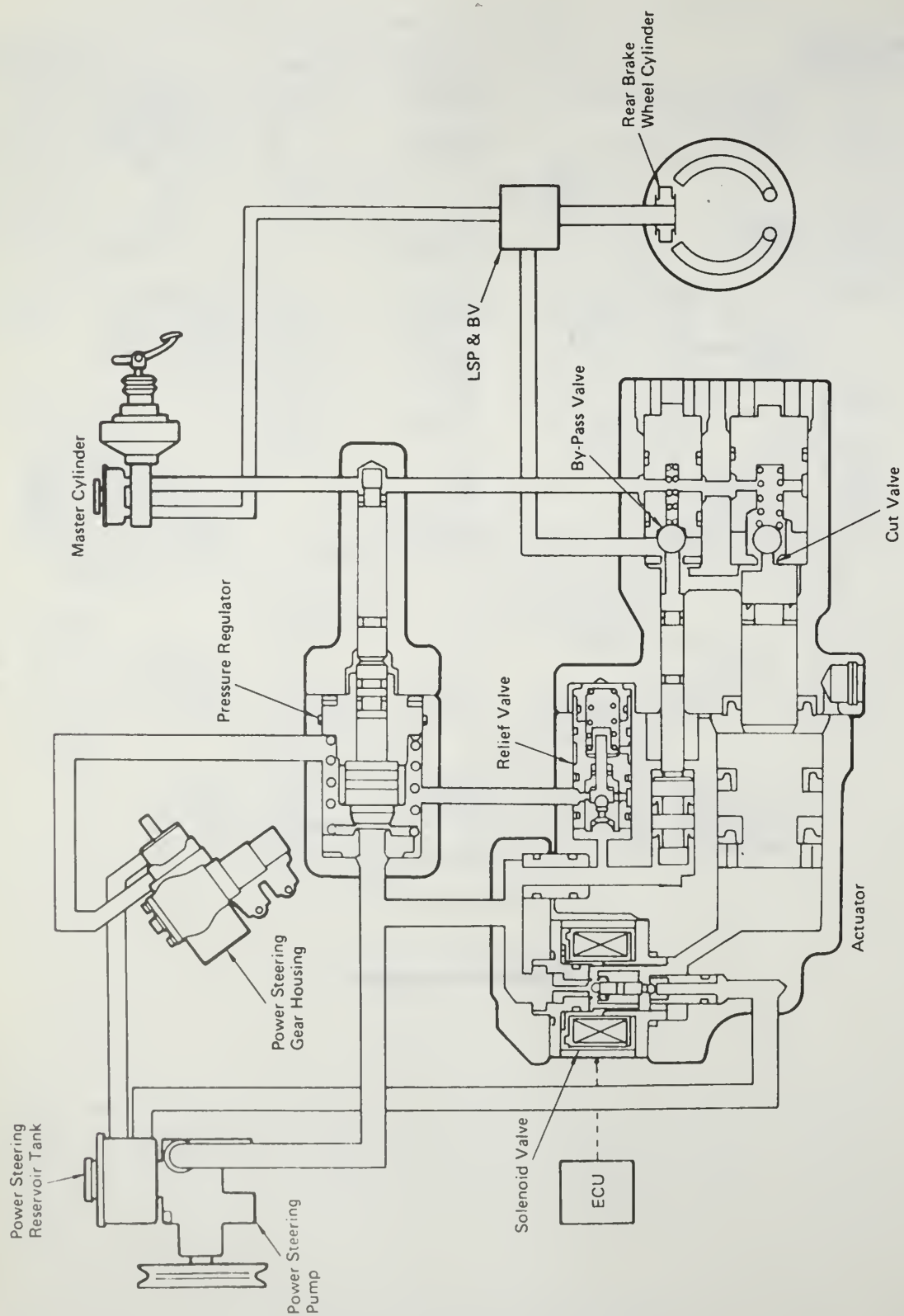


Anti-lock brake system



Anti-lock brake system

6 CHASSIS ELECTRICAL



Anti-lock brake system

7

Drive Train

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7 DRIVE TRAIN

UNDERSTANDING THE MANUAL TRANSMISSION

Because of the way an internal combustion engine breathes, it can produce torque, or twisting force, only within a narrow speed range. Most modern engines produce their peak torque in a very narrow range. By about 4500–5000 rpm, they are producing so little torque that continued increases in engine speed produce no power increase.

The manual transmission and clutch are employed to vary the relationship between engine speed and the speed of the wheels so that adequate engine power can be produced under all circumstances. The clutch allows engine torque to be applied to the transmission input shaft gradually, due to mechanical slippage. The car can, consequently, be started smoothly from a full stop.

The transmission changes the ratio between the rotating speeds of the engine and the wheels by the use of gears. 4-speed or 5-speed transmissions are most common. The lower gears allow full engine power to be applied to the rear wheels during acceleration at low speeds.

The clutch drive plate is a thin disc, the center of which is splined to the transmission input shaft. Both sides of the disc are covered with a layer of material similar to brake lining and capable of allowing slippage without roughness or excessive noise.

The clutch cover or pressure plate assembly is bolted to the engine flywheel and incorporates a diaphragm spring which provides the pressure to engage the clutch. The cover also houses the pressure plate. The driven disc is sandwiched between the pressure plate and the smooth surface of the flywheel when the clutch pedal is released, thus forcing it to turn at the same speed as the engine crankshaft.

The transmission contains a mainshaft which passes all the way through the transmission, from the clutch to the drive-shaft. This shaft is separated at one point, so that front and rear portions can turn at different speeds.

Power is transmitted by a countershaft in the lower gears and reverse. The gears of the countershaft mesh with gears on the mainshaft, allowing power to be carried from one to the other. All the countershaft gears are integral with that shaft, while several of the mainshaft gears can either rotate independently of the shaft or be locked to it. Shifting from one gear to the next causes one of the gears to be freed from rotating with the shaft and locks another to it. Gears are locked and unlocked by internal dog clutches which slide between the center of the gear and the shaft. The forward gears usually employ synchronizers; friction members which smoothly bring gear and shaft to the same speed before the toothed dog clutches are engaged.

The clutch is operating properly if:

1. It will stall the engine when released with the vehicle held stationary.
2. The shift lever can be moved freely between 1st and reverse gears when the vehicle is stationary and the clutch disengaged.

A clutch pedal free-play adjustment is incorporated in the linkage. If there is about 25-50mm of motion before the pedal begins to release the clutch, it is adjusted properly. Inadequate free-play wears all parts of the clutch releasing mechanisms and may cause slippage. Excessive free-play may cause inadequate release and hard shifting of gears.

Some clutches use a hydraulic system in place of mechanical linkage. If the clutch fails to release, fill the clutch master cylinder with fluid to the proper level and pump the clutch pedal to fill the system with fluid. Bleed the system in the same way as a brake system; the bleeder is located on the slave cylinder. If leaks are located, tighten loose connections or overhaul the master or slave cylinder as necessary.

MANUAL TRANSMISSION

The manual transmissions found in trucks and 4Runners are denoted by their Toyota model designations: G40, G57, G58, W46, W55, W56, R150 and R150F. The G40 and W46 units are 4-speed transmissions; the others are 5-speeds. The G58, W56 and R150F are used in 4WD applications and are connected to the transfer case. The R150F is coupled to the 3VZ-E engine in 4WD applications. All models utilize a floor-mounted shifter and an internally-separated shift linkage. No external adjustments are either necessary or possible.

Back-Up Light Switch

REMOVAL AND INSTALLATION

1. Position the shift lever in neutral.
2. Raise the truck and support it on safety stands.
3. Disconnect the electrical connector at the switch.
4. Unscrew the back-up light switch from the extension housing.

5. Screw the new switch into the housing and tighten it to 60 inch lbs.
6. Connect the wire and lower the truck.

Transmission

REMOVAL AND INSTALLATION

Pickup — 2WD

1. Disconnect the negative battery cable.
2. Remove the four bolts holding the fan shroud.
3. Remove the shift lever boot retainer. Pull up the boot and cover the shift lever cap with a cloth. Press down on the shift lever cap and turn it counterclockwise to remove it. Remove the shift lever.
4. Raise the truck and support it on safety stands. Double check the supports for secure placement.

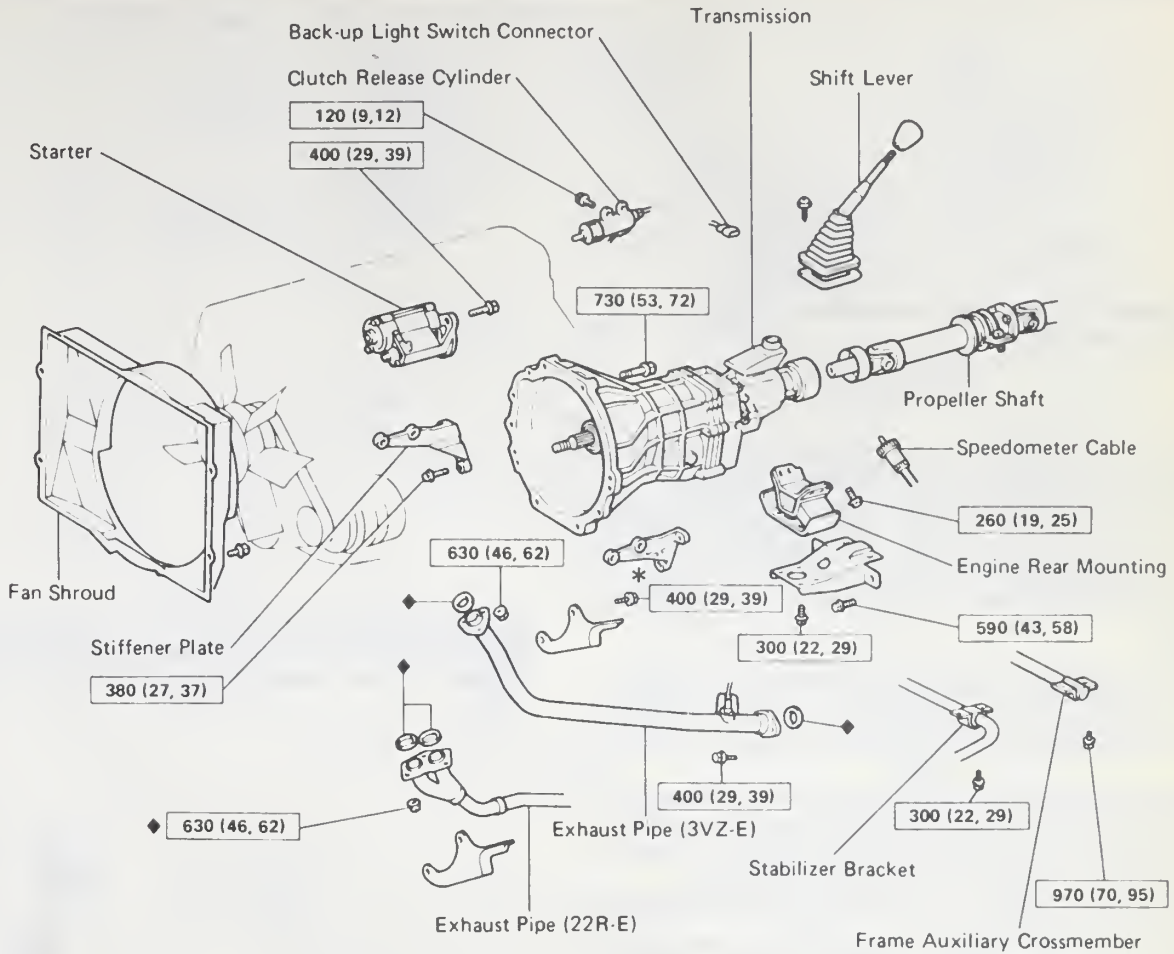
Troubleshooting the Manual Transmission

Problem	Cause	Solution
Transmission shifts hard	• Clutch adjustment incorrect • Clutch linkage or cable binding • Shift rail binding • Internal bind in transmission caused by shift forks, selector plates, or synchronizer assemblies • Clutch housing misalignment • Incorrect lubricant • Block rings and/or cone seats worn	• Adjust clutch • Lubricate or repair as necessary • Check for mispositioned selector arm roll pin, loose cover bolts, worn shift rail bores, worn shift rail, distorted oil seal, or extension housing not aligned with case. Repair as necessary. • Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary. • Check runout at rear face of clutch housing • Drain and refill transmission • Blocking ring to gear clutch tooth face clearance must be 0.030 inch or greater. If clearance is correct it may still be necessary to inspect blocking rings and cone seats for excessive wear. Repair as necessary.
Gear clash when shifting from one gear to another	• Clutch adjustment incorrect • Clutch linkage or cable binding • Clutch housing misalignment • Lubricant level low or incorrect lubricant • Gearshift components, or synchronizer assemblies worn or damaged	• Adjust clutch • Lubricate or repair as necessary • Check runout at rear of clutch housing • Drain and refill transmission and check for lubricant leaks if level was low. Repair as necessary. • Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary.
Transmission noisy	• Lubricant level low or incorrect lubricant • Clutch housing-to-engine, or transmission-to-clutch housing bolts loose • Dirt, chips, foreign material in transmission • Gearshift mechanism, transmission gears, or bearing components worn or damaged • Clutch housing misalignment	• Drain and refill transmission. If lubricant level was low, check for leaks and repair as necessary. • Check and correct bolt torque as necessary • Drain, flush, and refill transmission • Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary. • Check runout at rear face of clutch housing

7 DRIVE TRAIN

Troubleshooting the Manual Transmission

Problem	Cause	Solution
Jumps out of gear	• Clutch housing misalignment • Gearshift lever loose • Offset lever nylon insert worn or lever attaching nut loose • Gearshift mechanism, shift forks, selector plates, interlock plate, selector arm, shift rail, detent plugs, springs or shift cover worn or damaged • Clutch shaft or roller bearings worn or damaged	• Check runout at rear face of clutch housing • Check lever for worn fork. Tighten loose attaching bolts. • Remove gearshift lever and check for loose offset lever nut or worn insert. Repair or replace as necessary. • Remove, disassemble and inspect transmission cover assembly. Replace worn or damaged components as necessary. • Replace clutch shaft or roller bearings as necessary
Jumps out of gear (cont.)	• Gear teeth worn or tapered, synchronizer assemblies worn or damaged, excessive end play caused by worn thrust washers or output shaft gears • Pilot bushing worn	• Remove, disassemble, and inspect transmission. Replace worn or damaged components as necessary. • Replace pilot bushing
Will not shift into one gear	• Gearshift selector plates, interlock plate, or selector arm, worn, damaged, or incorrectly assembled • Shift rail detent plunger worn, spring broken, or plug loose • Gearshift lever worn or damaged • Synchronizer sleeves or hubs, damaged or worn	• Remove, disassemble, and inspect transmission cover assembly. Repair or replace components as necessary. • Tighten plug or replace worn or damaged components as necessary • Replace gearshift lever • Remove, disassemble and inspect transmission. Replace worn or damaged components.
Locked in one gear—cannot be shifted out	• Shift rail(s) worn or broken, shifter fork bent, setscrew loose, center detent plug missing or worn • Broken gear teeth on countershaft gear, clutch shaft, or reverse idler gear • Gearshift lever broken or worn, shift mechanism in cover incorrectly assembled or broken, worn damaged gear train components	• Inspect and replace worn or damaged parts • Inspect and replace damaged part • Disassemble transmission. Replace damaged parts or assemble correctly.

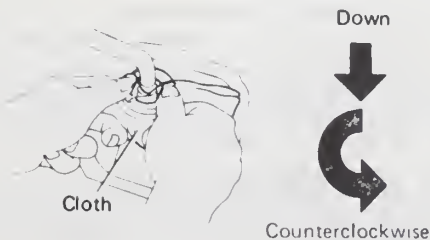


* 3VZ-E engine

kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

Manual transmission removal – 2WD



Shift lever removal – 2WD

5. Drain the fluid from the transmission.
6. Remove the driveshaft and plug the extension housing to prevent oil seepage.
7. Disconnect the speedometer cable.
8. Disconnect the backup light switch wire.

9. Remove the exhaust pipe clamp from the bracket; disconnect the exhaust pipe at the manifold and remove the clamp bracket from the clutch housing. For vehicles with 3VZ-E engines, remove the pipe bracket from the clutch housing first, then disconnect the pipe at the manifold and from the front of the catalytic converter.

10. Remove the clutch release cylinder mounting bolts and pipe bracket; position the cylinder out of the way. Do not disconnect the fluid line.

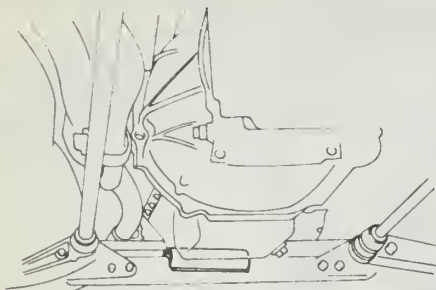
11. Remove the four bolts holding the stabilizer (sway) bar.

12. Remove the four bolts holding the frame auxiliary crossmember.

13. Remove the 4 rear engine mount bolts at the extension housing. Position a block of wood on a floor jack and raise the engine slightly. Remove the 4 rear mount-to-support member bolts and remove the rear engine mount. Remove the rear engine mount from the transmission.

14. Tape a piece of wood about 20mm (0.8 in.) thick onto the front crossmember and then lower the transmission.

7 DRIVE TRAIN



A piece of wood must be taped to the front crossmember

15. Remove the starter. Remove the stiffener plate bolts.
16. Remove the remaining transmission housing bolts.
17. With a floor jack under the transmission case, pull it toward the rear and slowly lower the front end until it can be removed from the truck. On models with the 3VZ-E and R150 transmission, turn the transmission about 45° clockwise and slide it toward the rear, lower the front and then remove it from the truck.

To install:

18. Insert the extension housing between the crossmember and the floor; slide the transmission forward. Position the transmission case so the input shaft splines align with the clutch disc and push it fully into position. Install the 2 upper mounting bolts.

19. Install the transmission housing and stiffener plate bolts. For 22R-E, install the starter. Tighten the transmission bolts to 53 ft. lbs. (72 Nm) and the stiffener plate bolts to 27 ft. lbs. (37 Nm). Tighten the starter bolt to 29 ft. lbs. (39 Nm).

20. Install the rear engine mount and bracket. Tighten the bolts to 19 ft. lbs. (25 Nm).

21. Raise the engine slightly and position the rear engine mount in the support member and tighten the bolts to 43 ft. lbs. (59 Nm).

22. Lower the transmission until it rests on the rear mount. Install the 4 bolts and tighten them to 22 ft. lbs. (29 Nm).

23. Remove the piece of wood from the front crossmember.

24. Install the exhaust pipe, bracket and clamp. Tighten the exhaust pipe bolts to 46 ft. lbs. (62 Nm). On 22R-E, tighten the upper pipe bracket bolts to 14 ft. lbs. (19 Nm) and the lower one to 51 ft. lbs. (69 Nm). On 3VZ-E, tighten the pipe bolts at the catalyst to 29 ft. lbs. (39 Nm).

25. On 22R-E, install the lower starter bolt. For 22R-E and 3VZ-E, install the clutch release cylinder and tube bracket. Tighten the starter bolt to 29 ft. lbs. (39 Nm) and the pipe bracket bolts (22R-E) to 53 ft. lbs. (72 Nm).

26. Install the clutch release cylinder and tighten the bolts to 9 ft. lbs. (12 Nm).

27. Install the stabilizer bar retaining bolts and tighten them to 22 ft. lbs. (29 Nm).

28. Install the frame auxiliary crossmember, tightening the bolts to 70 ft. lbs. (95 Nm).

29. Connect the speedometer cable. Connect the backup light switch.

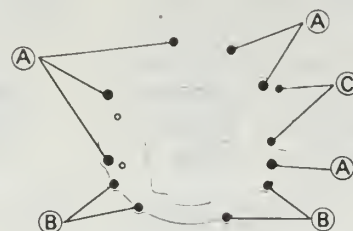
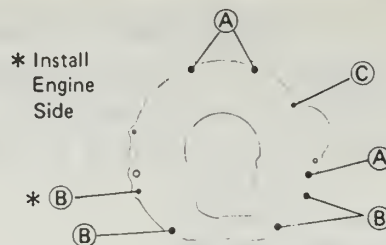
30. Remove the extension housing plug and install the driveshaft.

31. Fill the transmission with oil and lower the truck.

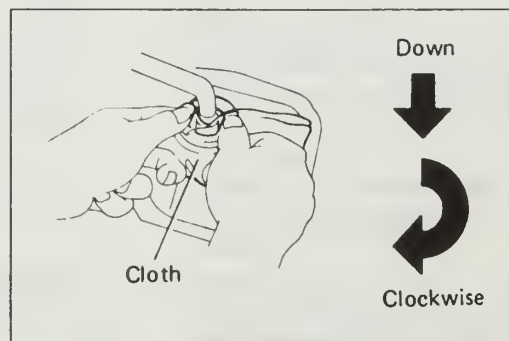
32. Apply multi-purpose grease to the shift lever; align the groove of the shift lever cap and the pin part of the case. Cover the shift lever cap with a cloth. Press down on the shaft and turn it clockwise to install. Install the shift lever boot and retainer with the four screws.

33. Install the fan shroud bolts.

34. Connect the battery cable and road test the truck.



Manual transmission bolts, 2WD; 22R-E (above) and 3VZ-E. Bolts "A" are transmission mounting bolts, "B" are stiffener plate bolts and "C" are starter bolts



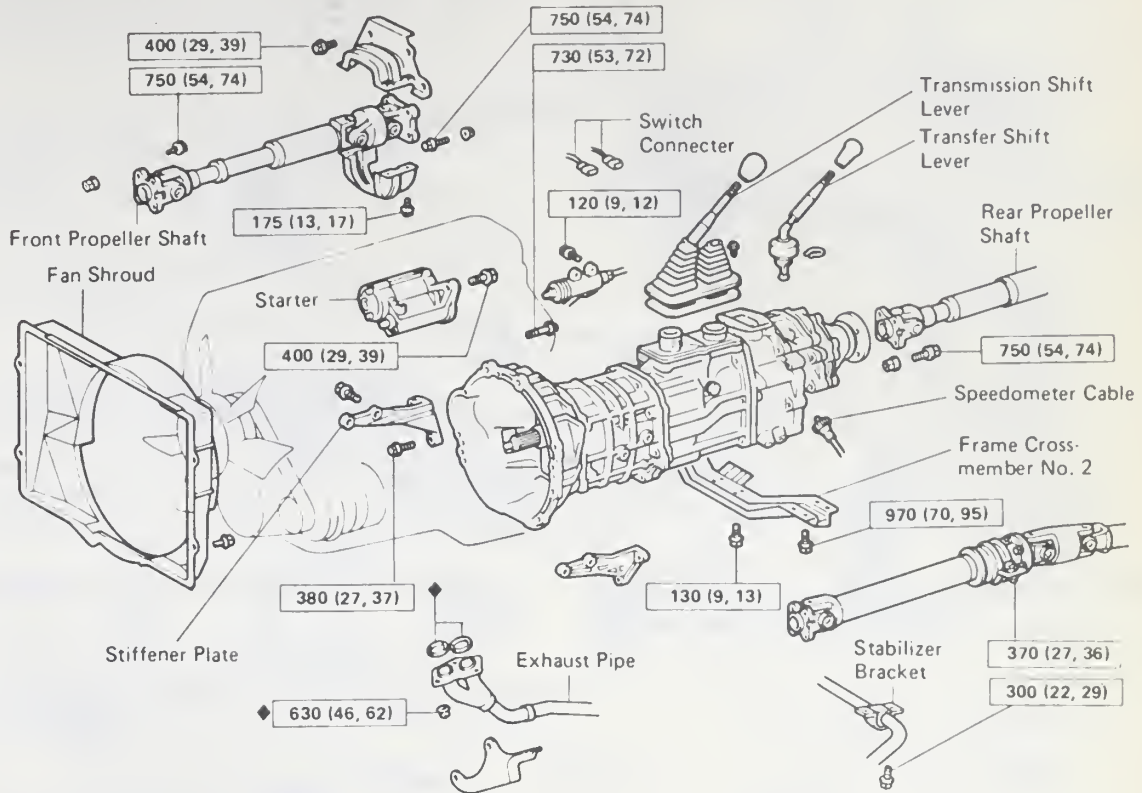
Make certain the shifter is firmly engaged after reinstallation

4WD Pickup and 4Runner

NOTE: The manual transmission on 4WD Toyota trucks is removed with the transfer case attached.

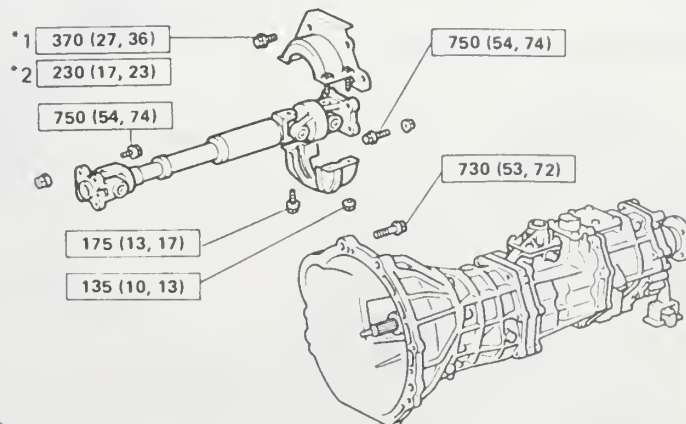
1. Disconnect the battery cables at the battery.
2. Remove the retaining bolts holding the fan shroud.
3. On 3VZ-E engines, loosen the clamp on the heater hose at the firewall and move the clamp up the heater hose out of the way.
4. Remove the four screws holding the shift lever boot retainer. Pull up the boot and cover the shift lever cap with a cloth. Press down on the shift lever cap, rotate it counterclockwise and remove the shift lever.
5. Using needle nose pliers, remove the transfer case shift lever retainer snapping, then remove the shift lever.
6. Raise the vehicle and support is securely with jackstands. Double check the placement and security of the stands.
7. Drain the lubricant from both the transmission and the transfer case.
8. Chalk matchmarks on the driveshaft flanges and the differential pinion flanges to indicate their relationships. These

[22R-E] W56 Transmission and Counter Gear Type Transfer



G58 Transmission and Planetary Gear Type Transfer

- *1 To transfer
- *2 To bracket



kg-cm (ft-lb, N-m) : Specified torque

◆ Non-reusable part

W56 transmission with counter-gear transfer case as used with 22R-E engine

marks must be aligned during installation. Remove the four bolts from each end of the front driveshaft and remove the driveshaft assembly. On vehicles with G58 and R150F transmissions, it is necessary to remove the propeller shaft dust cover before the shaft is removed.

9. Chalk matchmarks on the rear driveshaft and the slip yoke to indicate their relationships. These marks must be aligned during installation.

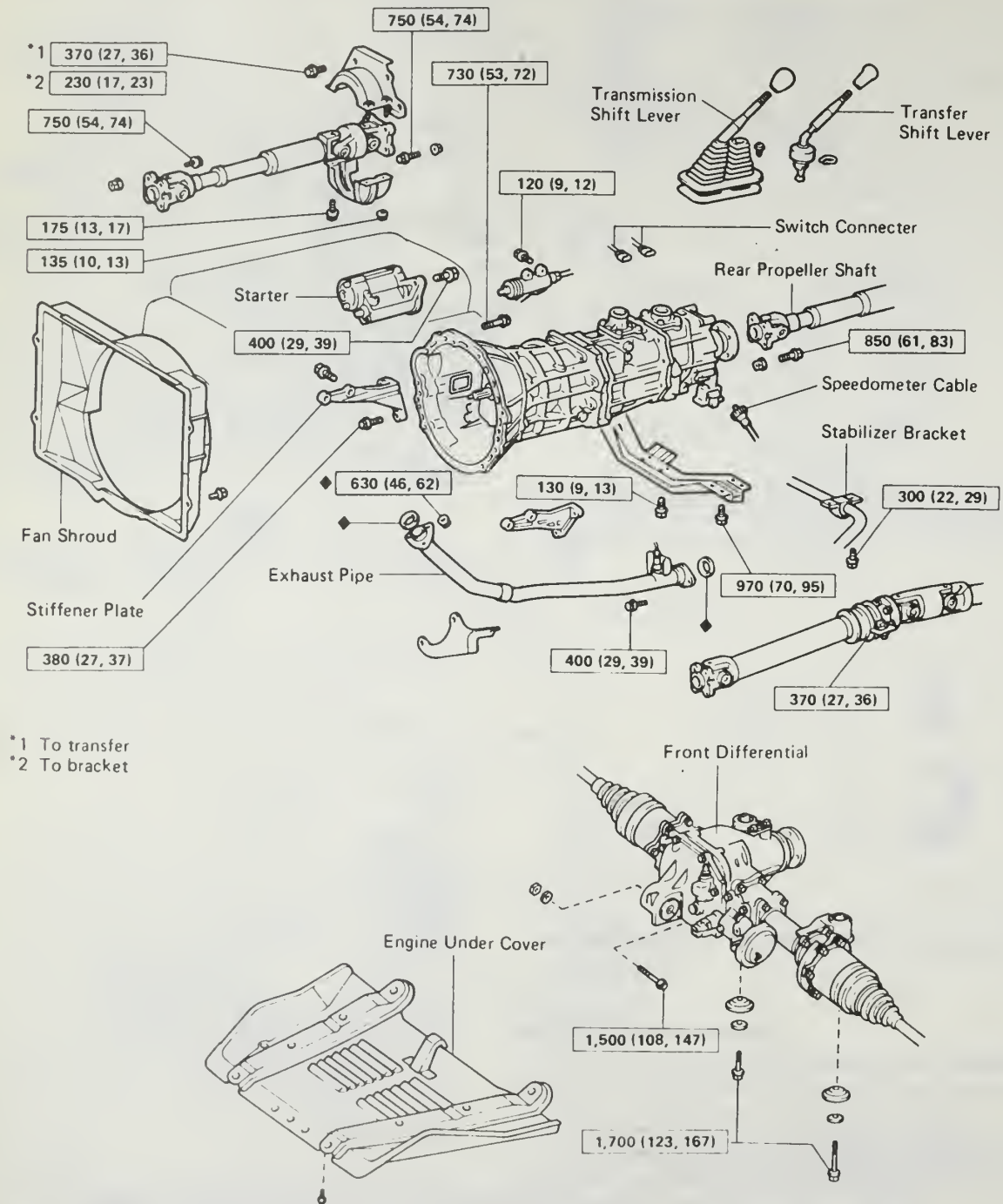
10. Remove the four bolts from the rearward flange of the rear driveshaft. Lower the driveshaft out of the vehicle. Remove the four bolts from the slip yoke flange then remove the flange and yoke assembly.

11. Disconnect the speedometer cable, reverse lamp switch connector and transfer switch connector.

12. On 3VZ-E engines, remove the exhaust pipe clamp, the exhaust bracket from the clutch housing and disconnect the ex-

7 DRIVE TRAIN

[3VZ-E] R150F Transmission and Planetary Gear Type Transfer



*1 To transfer
*2 To bracket

kg-cm (ft.-lb, N-m) Specified torque

◆ Non-reusable part

R150 transmission with planetary gear transfer case as used with 3VZ-E engine

haust pipe at the exhaust manifold. Disconnect the exhaust pipe from the front of the catalyst and remove the pipe. On 22R-E, remove the bolts holding the exhaust pipe clamp to the trans-

mission and disconnect the exhaust pipe at the manifold. Support the pipe out of the way with wire or rope.

13. Disconnect the clutch release cylinder (slave cylinder) re-

taining bolts and move the cylinder out of the way with the line attached. On 22R-E, the piping bracket must also be removed.

14. On 3VZ-E, support the front differential with a floor jack; remove the 3 bolts holding the front differential.

15. Remove the 4 bolts holding the stabilizer (sway) bar brackets.

16. Remove the 4 bolts from the rear engine mount. Raise the transmission slightly with a jack. remove the eight bolts from the side frame rails and remove the No.2 crossmember.

17. For 22R-E, place a piece of wood between the engine oil pan and the front axle.

18. Lower the transmission and transfer case.

19. Remove the two bolts holding the starter; place or hang the starter alongside the motor.

20. remove the exhaust pipe bracket and the bolts in the stiffener plate.

21. Support the transmission and transfer case with a jack. Remove the remaining transmission mounting bolts.

22. Remove the transmission by moving it rearward; once clear, lower the front of the transmission and remove the unit from the vehicle.

23. Remove the breather hose between the transfer case and the transmission case.

24. Remove the rear engine mount from the transmission case.

25. If equipped with a dynamic damper at the rear of the case, remove it.

26. Remove the driveshaft upper dust cover from the bracket. Remove the mounting bolts for the transfer adapter.

27. Pull the transfer case straight off the end of the transmission. Do not damage the transfer case rear oil seal during removal.

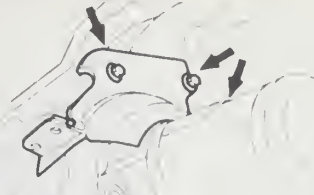
To install:

28. Move the two shift fork shafts to the HI-4 position.

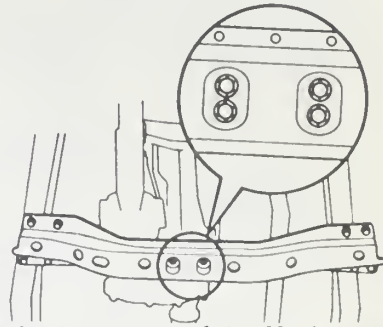
29. Apply multi-purpose grease to the adaptor oil seal. Install a new gasket on the transfer case adapter.

30. Install the transfer case to the transmission. Install and tighten the retaining bolts to 28 ft. lbs. (38 Nm).

31. Install the dust cover bolt to the bracket. Correct tightness is 17 ft. lbs. (23 Nm) for R150F and G58 units and 29 ft. lbs. (39 Nm) for W56 units.



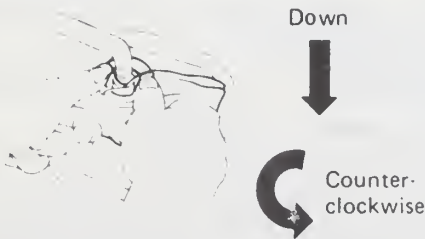
Propeller shaft dust cover for G58 and R150F



The 4 bolts in the center of the No.2 crossmember hold the rear engine mount



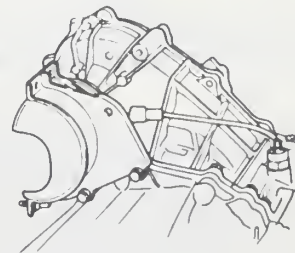
Not all units use a dynamic damper



Remove the transmission shifter by pressing down and turning



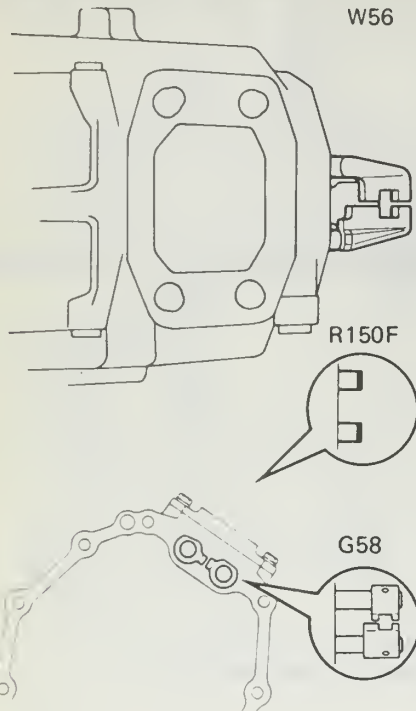
Removing the transfer shifter



The upper dust cover must be removed (above) before the transfer case is separated from the transmission



7 DRIVE TRAIN



Correct position of the shift selector shafts before reinstallation



3VZ-E bolt installation guide: Bolts "A" are transmission bolts, "B" are stiffener plate bolts and "C" are starter bolts

32. Install the rear engine mount, tightening the bolts to 19 ft. lbs. (25 Nm). Install the dynamic damper if it was removed and tighten the bolts to 27 ft. lbs. (37 Nm). Install the breather hose.

33. Support the transmission assembly on a jack. Move the unit into installation position and align the input shaft spline with the clutch disc. Push the transmission fully into position.

34. Install the transmission and stiffener bolts. On 3VZ-E, install the starter. Tighten the transmission bolts to 53 ft. lbs. (72 Nm), the stiffener bolts to 27 ft. lbs. (37 Nm). Tighten the starter bolts to 29 ft. lbs. (39 Nm).

35. Raise the transmission slightly with a jack. Install the No. 2 frame crossmember and tighten the bolts to 70 ft. lbs. (95 Nm).

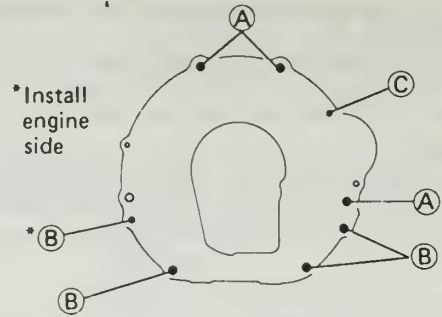
36. Lower the transmission assembly. Install the 4 bolts to the engine rear mount; tighten them to 9 ft. lbs. (13 Nm).

37. Install the stabilizer bracket bolts, tightening them to 22 ft. lbs. (29 Nm).

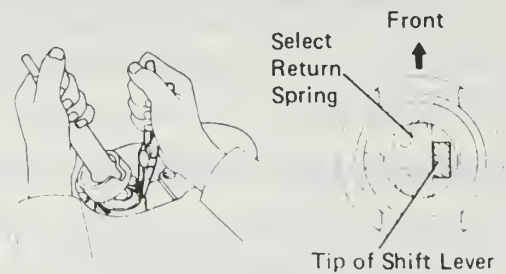
38. For 22R-E, remove the piece of wood from the front axle.

39. For 3VZ-E, install the front differential bolts. Tighten the bolt holding the carrier cover to the frame to 108 ft. lbs. (147 Nm); tighten the others to 123 ft. lbs. (167 Nm).

40. Install the exhaust pipe. For 3VZ-E, tighten the manifold bolts to 46 ft. lbs. (62 Nm), the bracket to the clutch housing to 29 ft. lbs. (39 Nm) and the exhaust pipe clamp to 14 ft. lbs. (19



22R-E bolt installation guide: Bolts "A" are transmission bolts, "B" are stiffener plate bolts and "C" are starter bolts



Installation of transfer shifter

Nm). On 22R-E, tighten the manifold bolts to 46 ft. lbs. (62 Nm), the upper clutch housing clamp bolt to 14 ft. lbs. (19 Nm), the lower bolt to 51 ft. lbs. (69 Nm) and the clamp bolt to 14 ft. lbs. (19 Nm).

41. Install the clutch cylinder; tighten the bolts to 9 ft. lbs. (12 Nm); on 22R-E, install the lower starter bolt and tighten it to 29 ft. lbs. (39 Nm).

42. Install the propeller shaft dust cover assembly if one was removed.

43. Connect the speedometer cable, reverse light switch and transfer indicator switch wiring.

44. Install the driveshafts.

45. Fill the transmission and the transfer case with the proper amount of oil.

46. Lower the vehicle to the ground.

47. Install the transfer shift lever and secure it with the snapping.

48. Install the transmission shift lever. Lightly grease the lever; align the groove of the shift lever cap and the pin of the case cover. Cover the shift lever cap with a cloth; press down on the cap and rotate the lever clockwise to install the lever.

49. On 3VZ-E, move the clamp on the heater hose to the correct location and secure the clamp.

50. Install the retaining bolts in the fan shroud.

51. Connect the negative battery terminal.

52. Test drive the vehicle, operating it in all transmission and drive modes. Check for correct operation, ease of shifting, etc.

OVERHAUL

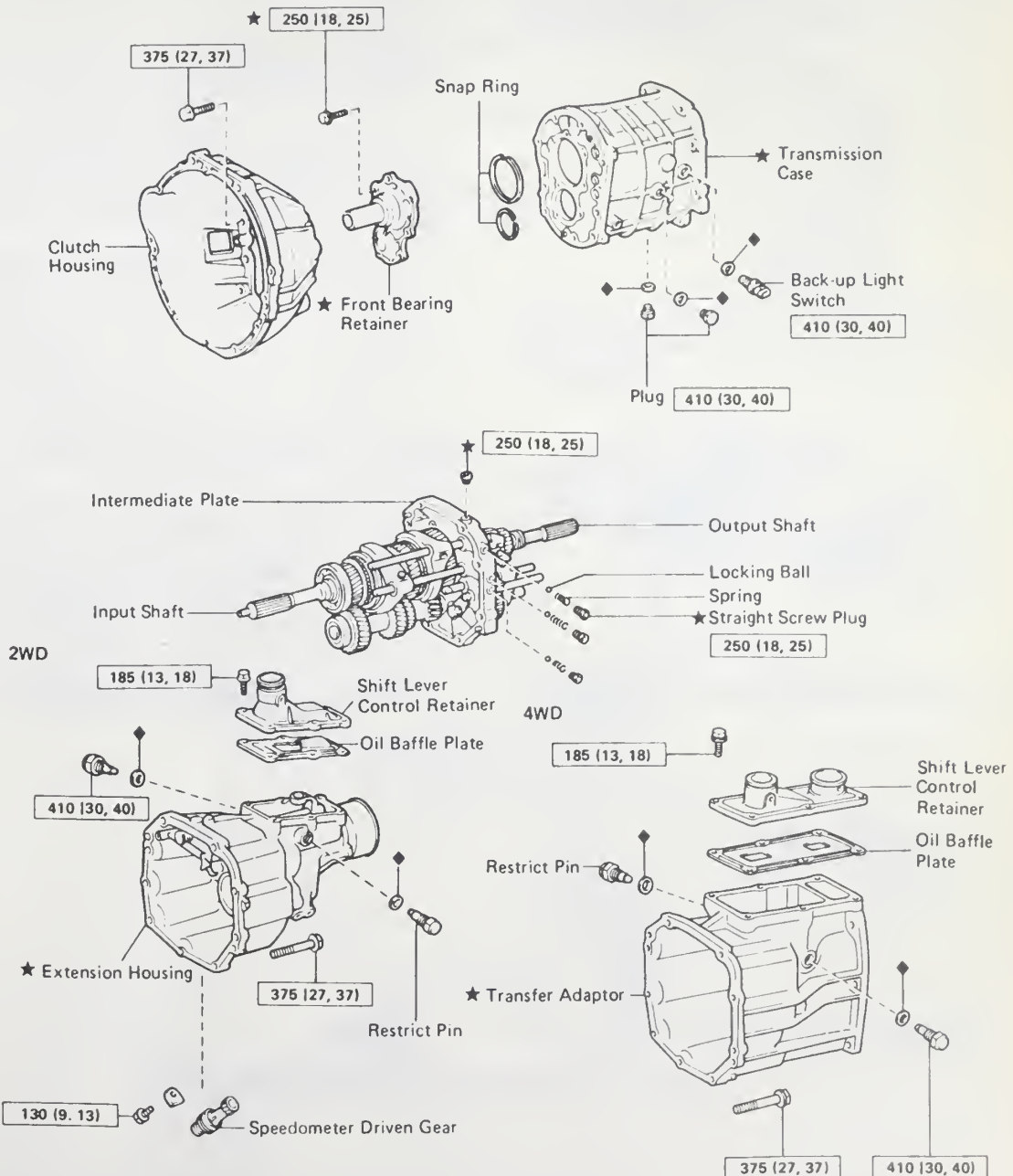
W-Series

NOTE: These procedures are for 5-speed transmissions. W46 speed unit is similar.

1. Remove the clutch release fork and bearing.
2. Remove the reverse lamp switch and, on 2WD units, remove the speedometer driven gear.

3. Remove the clutch housing, with the release fork, bearing and hub still attached.
4. Remove the gearshift lever retainer.
5. Rotate the shift rod housing counterclockwise (viewed from behind) and then disconnect the rod from the shift fork shafts.
6. Unbolt and remove the extension housing.
7. Drive out the slotted pin and separate the shift rod, housing and spring.
8. Remove the front bearing retainer.

9. Take off both of the front countershaft covers, and the spacer.
10. Remove the snaprings from the input and countershaft bearings.
11. Remove the intermediate plate.
12. When removing the intermediate plate, leave all the gears and other parts attached.
13. Remove the speedometer driven gear. There are two reverse restrictor pins. The pins are located underneath plugs on the extension housing.



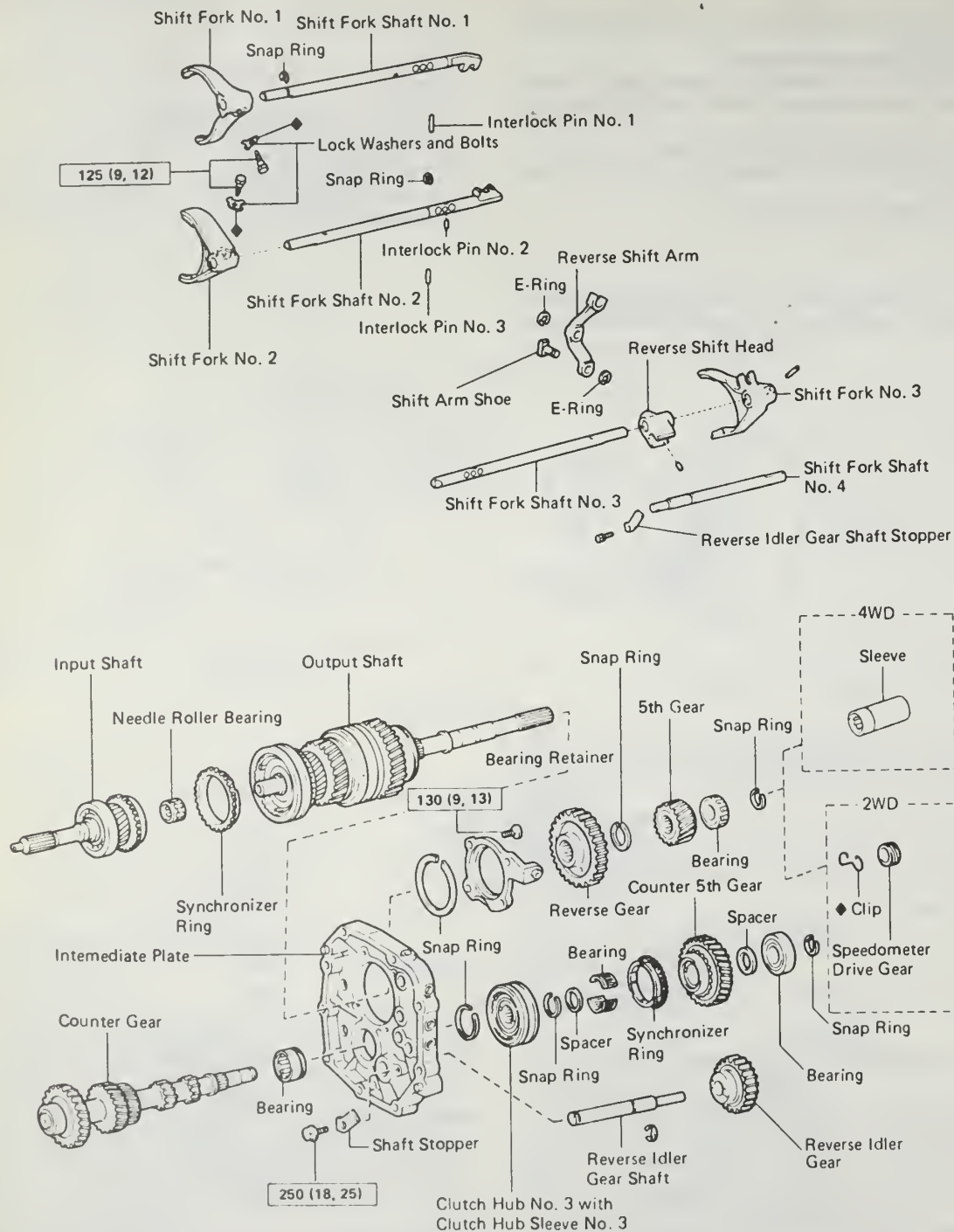
kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

★ Precoated part

W-series transmission unit components. Correct torque values must be observed during assembly

7 DRIVE TRAIN



kg-cm (ft-lb, N-m) : Specified torque
◆ Non-reusable part

W-series transmission gear and shaft components

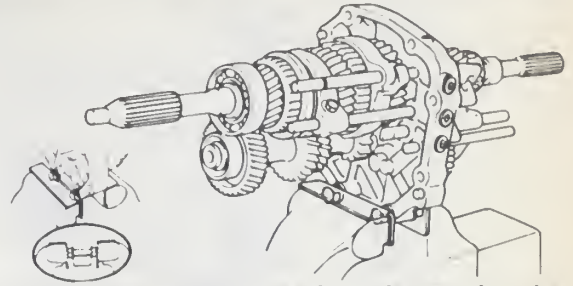
14. Remove the straight screw plugs from the shift forks and withdraw the springs.
15. Drive the slotted spring pins out of each shift fork.
16. Slide the gear shift fork shafts back and remove the forks.

17. Remove the speedometer drive gear snapping and remove the drive gear.
18. Remove the output shaft bearing.
19. Remove the countershaft bearing.

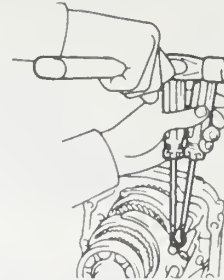
20. Remove the 5th and reverse gears from the countershaft.
21. Remove the snapring, 5th gear, its synchronizer ring, needle roller bearing, and 5th gear bearing inner race from the output shaft.
22. Remove the reverse gear and clutch hub from the output shaft.
23. Loosen the bolt and remove the reverse idler gear stop from the rear cover. Withdraw the reverse idler shaft from the rear; remove the reverse idler gear and spacer.
24. Remove the output shaft rear bearing retainer. Remove the rear bearing snapring.
25. Push the countergear bearing outer race rearward, and remove the bearing. Separate the countergear from the intermediate plate.
26. Separate the input shaft and synchronizer ring from the output shaft.
27. Remove the output shaft from the intermediate plate.
28. Remove the hub and synchronizer ring, followed by 3rd gear.
29. Press off the rear bearing.
30. Remove the following items from the output shaft, in the order listed: 1st gear. Roller bearing with inner race. Synchronizer ring. Reverse gear. Clutch hub. 2nd gear. Synchronizer ring.

To assemble:

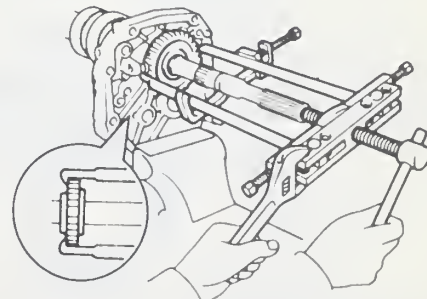
31. Install the sleeve over the 3rd gear synchronizer hub. Insert the three shift keys into the hub and sleeve keyways. Install the hub two springs.
32. Assemble the synchronizer ring to 3rd gear, and fit both of them on the output shaft.
33. Insert the 3rd/4th synchronizer hub on the output shaft, until it contacts the shoulder of the shaft.
34. Select a snapring to provide 0.05mm axial play for the synchronizer hub and fit it onto the shaft. Snaprings are available in a range of sizes.
35. Measure 3rd gear thrust clearance with a feeler gauge. The clearance should be 0.10-0.25mm. Replace 3rd gear if the clearance exceeds the limit of 0.25mm.
36. Install the synchronizer ring for 2nd gear to the gear and install the assembly on the output shaft.
37. Install the reverse gear over its clutch hub.
38. Install the reverse gear and hub on the output shaft so that they contact the shoulder.
39. Measure 2nd gear thrust clearance; it should be between 0.10-0.25mm. Replace the gear if the clearance is more than 0.25mm.



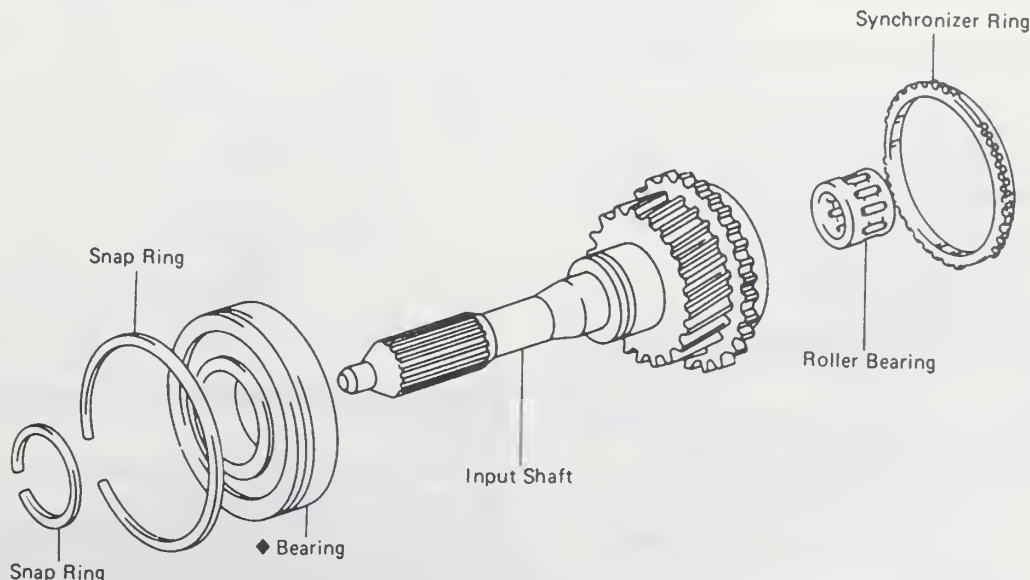
Mount the intermediate plate in a vise so that the vise does not contact the plate but bears on the nuts and bolts installed in the bottom



Two screwdrivers and a hammer can be very useful in removing some snap rings; others will require snap ring pliers

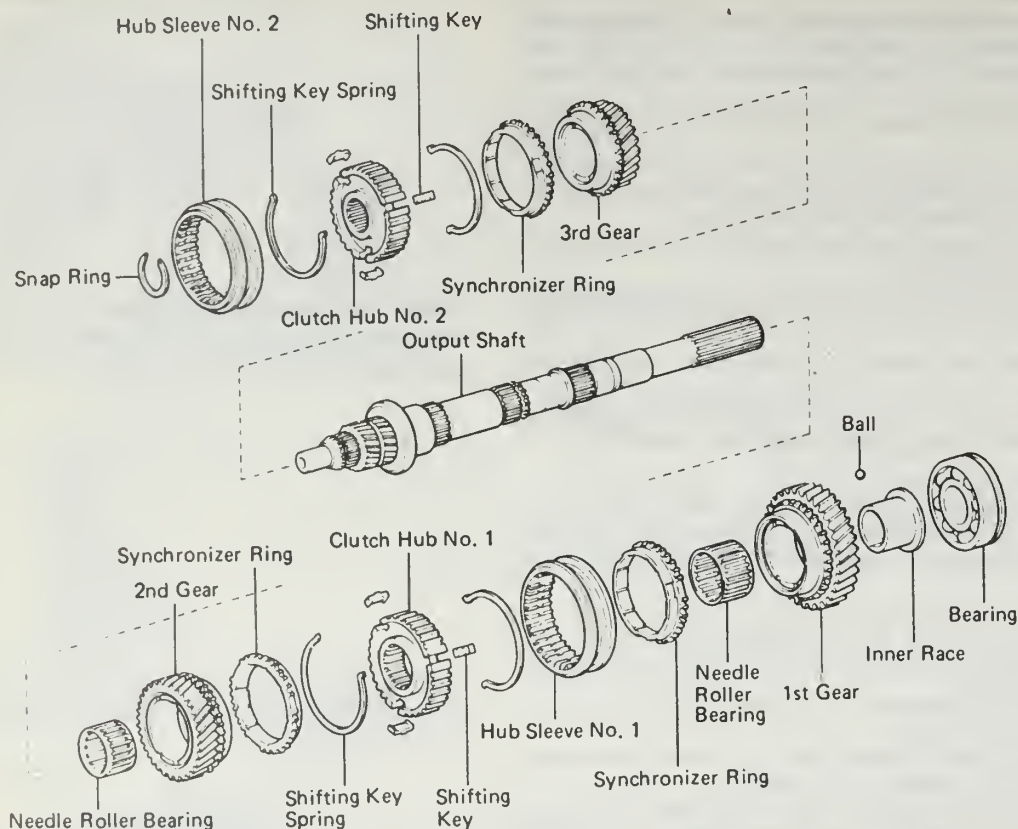


A large puller is required to remove reverse gear

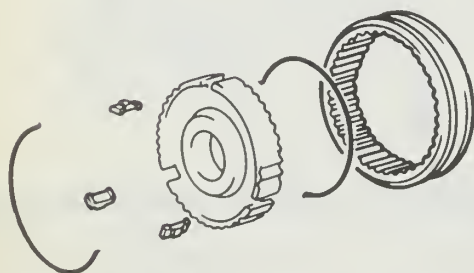


Input shaft components

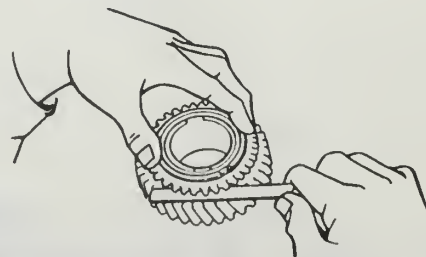
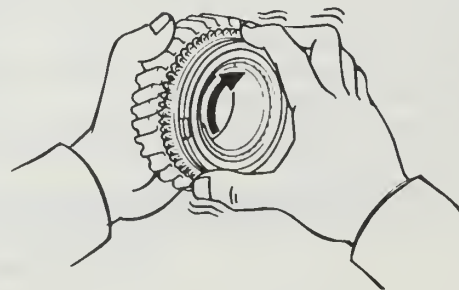
7 DRIVE TRAIN



Output shaft components



Disassembling the hub sleeve and clutch hub



Inspect the synchronizer for both locking and proper clearance

40. Coat the locking ball with grease. Insert it, and the roller bearing inner race, on the output shaft.

41. Assemble 1st gear with its synchronizer ring, bearing and bearing inner race. Install them on the output shaft, so that the end of the inner race contacts the clutch hub and the groove on the inner race aligns with the locking ball.

42. Press the rear bearing onto the output shaft.

43. Measure 1st gear thrust clearance.

NOTE: The thrust clearance of all gears in the should be between 0.15-0.25mm; the thrust clearance limit for all gears is 0.30mm.

44. Use a press to insert the straight pin into the intermediate plate, until it protrudes $\frac{1}{4}$ in. from the cover front side.

45. Install the output shaft on the intermediate plate.

46. Coat the roller bearing with grease and install it over the input shaft.

47. Apply gear oil to the front synchronizer ring on the output shaft.

48. Assemble the output shaft and the input shaft.

49. Install the countergear on the intermediate plate.

50. Install the cylindrical roller bearing into the intermediate plate, and then install the spacer.

51. Assemble the output shaft and countergear, then fit them through the holes in the intermediate plate. Push them in until the snapping sticks out beyond the intermediate plate. Install the snapping and then push the shafts back until the snapping is flush with the intermediate plate surface.

52. Install the shaft through the reverse idler gear. Insert the end of the shaft into the end of the intermediate plate.

53. Install the spacer on the idler shaft and secure it with a snapping.

54. Lock the reverse idler shaft on the intermediate plate with its stop. Check the reverse idler gear thrust clearance, it should be 0.15-0.25mm.

55. Install the reverse clutch hub on the reverse gear.

56. Install the three shift keys into the hub keyways and secure them with the two springs and a snapping.

57. Slide the reverse gear hub over the output shaft until it registers against the inner race of the intermediate plate bearing.

58. Insert the inner race lock ball into the output shaft bore, after greasing it so that it can't fall out.

59. Assemble 5th gear, its synchronizer ring, needle roller bearing, and race. Slide the assembly onto the output shaft until the inner bear face rests against the reverse clutch hub. Be sure that the inner race groove is aligned with the lock ball.

60. Secure 5th gear with a snapping.

61. Measure 5th gear thrust clearance; it should be 0.10-0.25mm. The thrust clearance limit is 0.30mm.

62. Install the countershaft reverse gear so that it just rests against the bearing inner race. Install the countershaft 5th gear and then install the countershaft bearing with a brass drift.

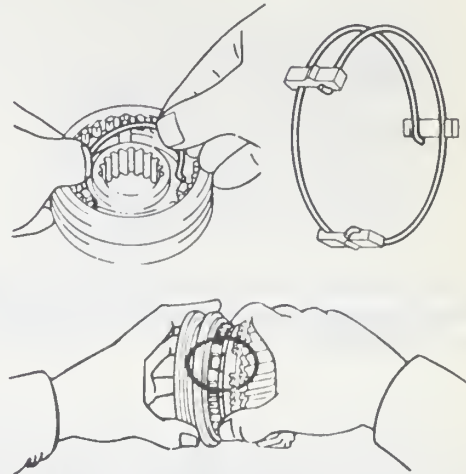
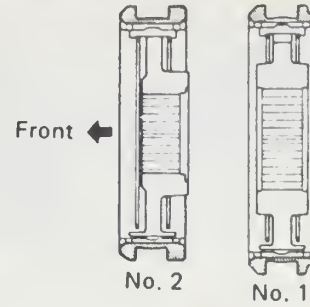
63. Install a snapping on the countershaft; select a snapping from one of the four available sizes.

64. Install a snapping on the output shaft, and drive its bearing into place with a brass drift. Coat the bearing with grease first.

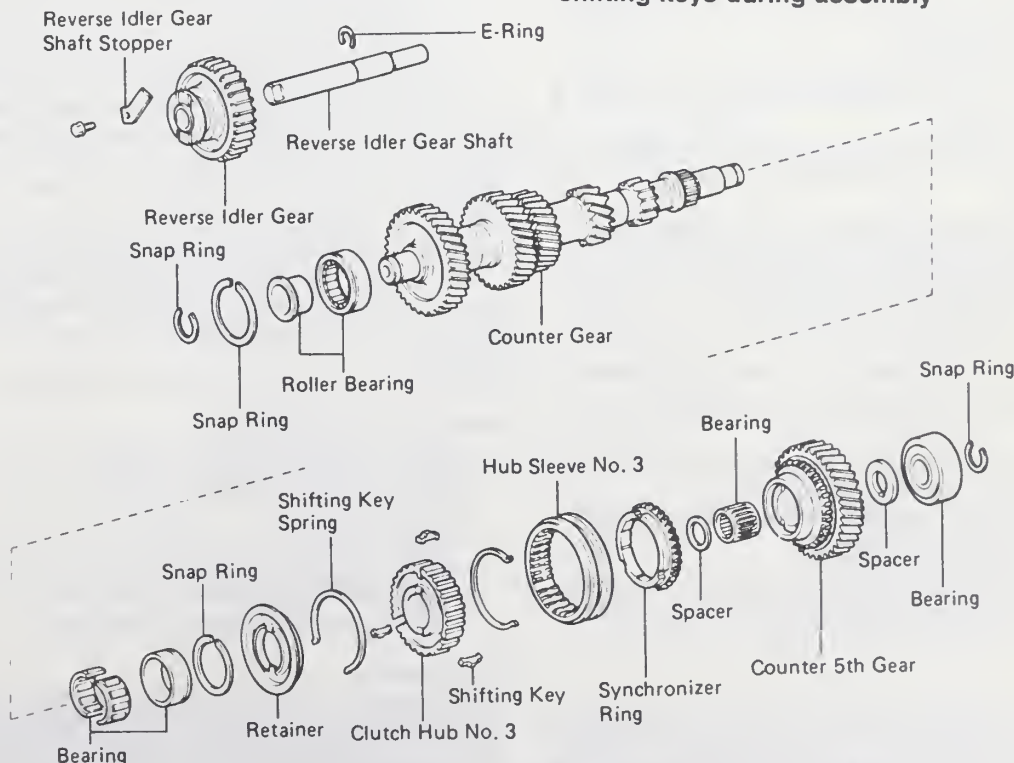
65. Install the spacer, ball, and speedometer drive gear on the output shaft.

66. Install the three shift forks in their hub sleeve grooves. Install the 1st and 3rd shift fork shafts and secure them with their interlock pins. Install the 2nd shift fork shaft next.

NOTE: Place each shift fork shaft in Neutral during assembly.

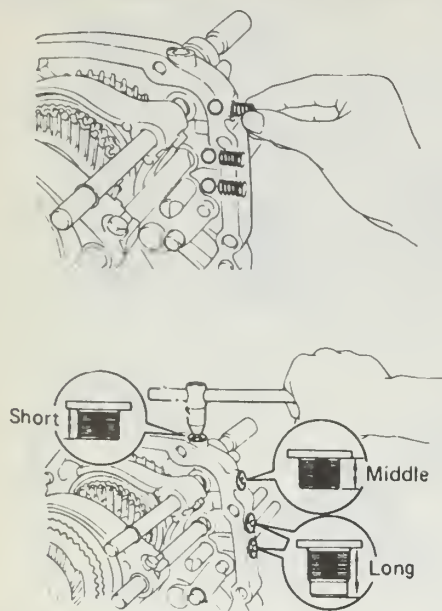


Correct assembly (above) of the hubs and hub sleeves; note that the spring ends are not aligned, but overlap. The ring slot must be aligned with the shifting keys during assembly



Counter shaft and reverse idler gear components

7 DRIVE TRAIN



Installing the locking balls and springs. Apply liquid sealer to the plug threads before installation and note correct placement

67. Secure the shift fork shafts to the end cover by inserting the lock balls into their bores, followed by the lock ball springs.
68. Use a new gasket between the transmission case and the intermediate plate. Slide the case into place.
69. Fit snaprings on the input shaft and countershaft front bearings.

70. Install the shift lever housing on the end of the shifter shaft. Slide the shifter shaft into the extension housing and secure it with a slotted spring pin.

71. Install a new gasket and slide the extension housing into place, until there is about 1 in. (25mm) of clearance between it and the intermediate plate.

72. Rotate the shift lever housing clockwise (as viewed from the rear) to engage the shifter shaft with the selector lever and the shift fork shaft.

73. Slide the extension housing the rest of the way.

74. Install the spacer and then the countershaft end covers.

75. Align the front bearing retainer gasket with the oil holes. Install the bearing retainer over the gasket.

76. Bolt the clutch housing onto the front of the transmission case.

77. Fit the restrictor pins and springs into their extension housing bores.

78. Install the shift lever retainer over the oil baffle on the extension housing.

79. Install the shift lever conical spring, large side down, and install the ball seat in the shift lever retainer.

80. Attach the shift lever retainer to the extension housing.

81. Install the speedometer driven gear.

82. Install the backup light switch.

83. Check to see that the input shaft has no more than 0.50mm end-play. Put the transmission in Neutral and see if the output shaft can be rotated freely by hand.

G-Series

1. Remove the backup light switch, speedometer driven gear, shift lever retainer and shift lever restrictor pins. Remove the clutch housing from the transmission.

2. From the side of the transfer case, remove the Torx® plug,

the spring and ball. Remove the Torx® plug from the back of the transfer adapter. Remove the shift lever housing set bolt and lock washer and remove the shift lever shaft and housing.

3. Remove the transfer adapter mounting bolts and the adapter.

4. Remove the front transmission mainshaft bearing retainer and the two snaprings.

5. Separate the intermediate mounting plate and gear assemblies from the transmission case.

6. Secure the intermediate plate and gear assemblies in a vise. Use blocks to prevent clamping directly on the aluminum intermediate plate.

7. Use a Torx® socket and remove the four plugs from the side of the intermediate plate. Remove the springs and ball from behind the plugs.

8. Remove the slotted spring pins using a pin punch and hammer. Remove the two E-rings from the shift shafts. Pull No. 4 shift fork shaft from the intermediate plate. Catch the locking balls and interlocking pin and remove the shift fork shaft No. 4 and No. 3 shift fork.

9. Pull out No. 5 shift fork shaft and remove it with the reverse shift head.

10. Pull out No. 3 shift fork shaft and No. 1 shift fork shaft from the intermediate plate. Pull out shift fork shaft No. 2 and remove shift fork No. 2 and No. 1.

11. Remove the reverse idler gear shaft stopper and remove the idler gear and shaft.

12. Remove the reverse shift arm from the reverse shift arm bracket.

13. Measure the 5th gear clearance on the countershaft. Clearance should be 0.01-0.03mm.

14. Remove the 5th gear synchronizer ring, needle bearings and 5th gear from the countershaft by engaging the gear and using a hammer and chisel to loosen the staked nut. Remove the nut, disengage the gear and, using a puller, remove the gear splined No. 5 synchronizer assembly, needle bearing and 5th gear from the countershaft.

15. Remove the spacer and ball from the countershaft. Remove the two bolts and the reverse shift arm bracket. Use a Torx® socket and remove the rear bearing retainer.

16. Remove the snapping from the main output shaft and remove the output shaft, countershaft and input shaft as an assembly. Separate the output shaft and needle bearings (14) from the input shaft. Remove the countershaft rear bearing from the intermediate plate. Remove the sleeve from the output shaft using an appropriate puller. Measure each gear thrust clearance, maximum clearance is 0.25mm.

17. Press off the 5th gear, rear bearing and 1st gear assemblies after removing the retaining snapping. Remove the locking ball.

18. Press off the No. 1 synchronizer assembly and 2nd gear. Remove the needle bearing. Remove the snapping and press off No. 2 synchronizer assembly and 3rd gear. Remove the needle bearing.

19. Inspect all parts and replace as necessary.

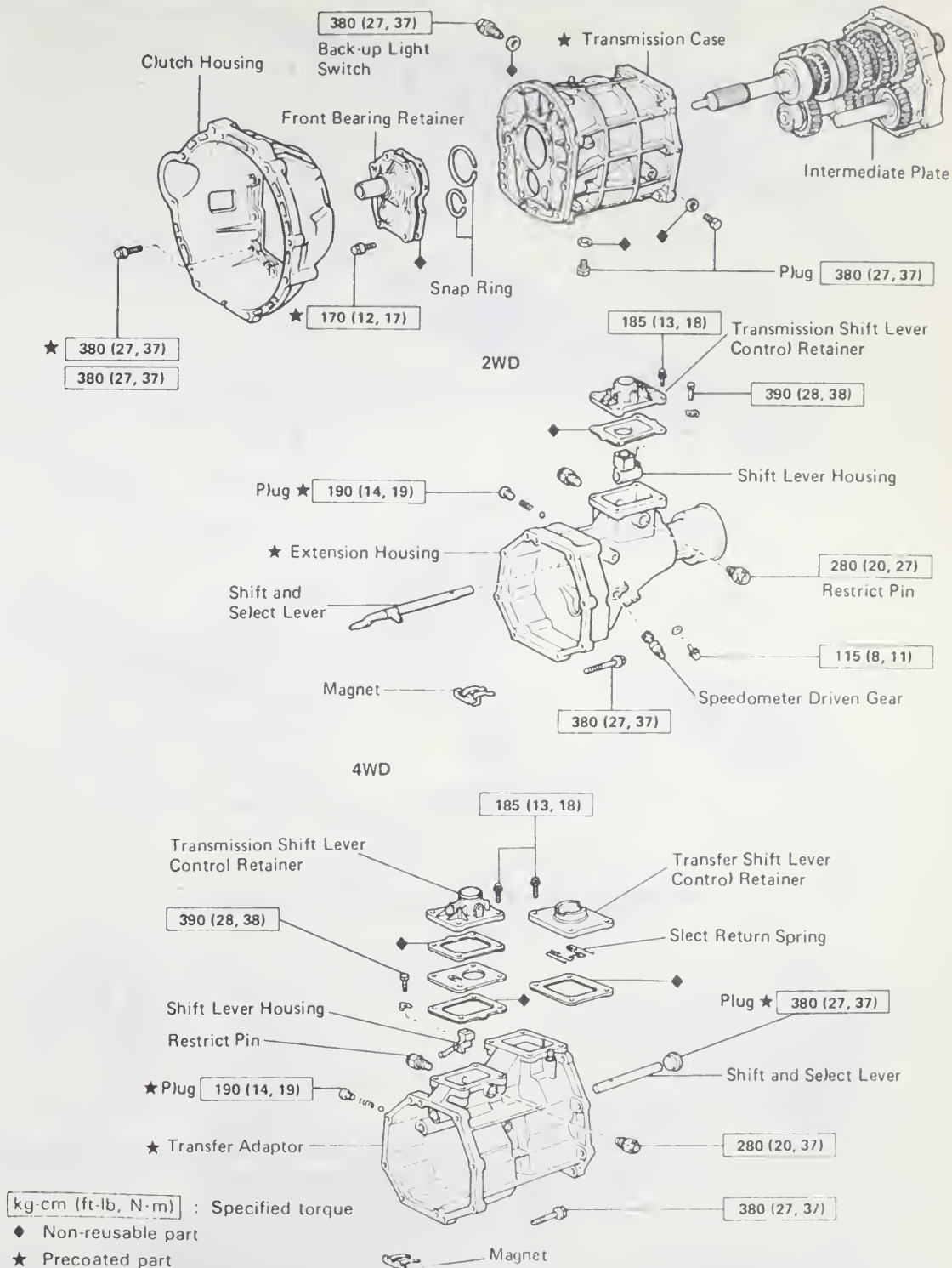
Required clearances:

- Output flange thickness: 4.8mm
- Inner race flange thickness: 4.0mm
- Output shaft journal thickness:
 - 2nd gear: 38mm
 - 3rd gear: 35mm
- Shaft out-of-round: 0.05mm
- Synchronizer ring clearance: 1.0-2.0mm
- Shift forks to hub sleeves: 1.0mm max.

To assemble:

20. Replace the grease retainers as necessary. Check and replace the input shaft and the countershaft front bearings if necessary. Select a snapping that will allow the minimum axial play.

21. Assemble the gears and synchronizers in the reverse order of removal. Make sure the synchronizers are installed facing in



G-series transmission unit components. Correct torque values must be observed during assembly

the proper direction. Use snaprings that will allow a minimum of axial play. Check clearances of all gears, synchronizers and bearings.

22. After the input, output and countershafts are ready for in-

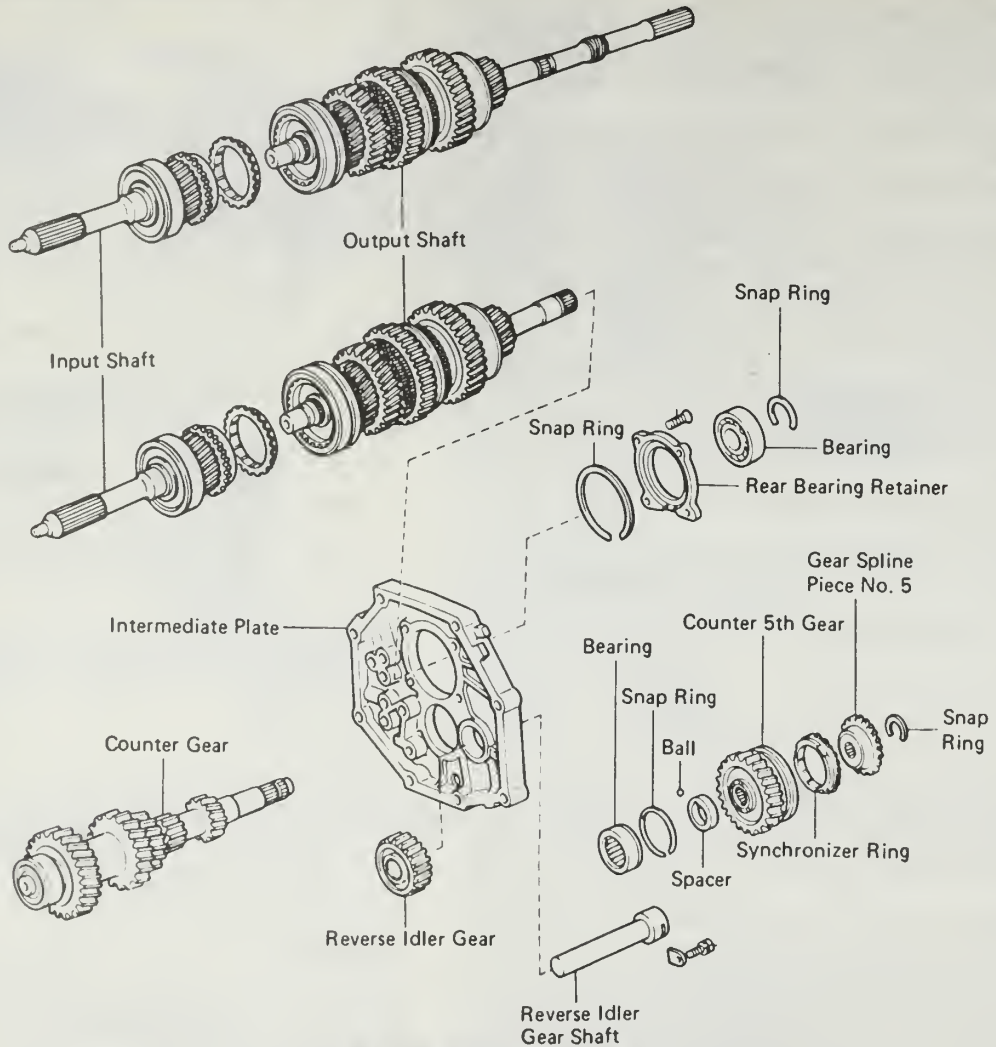
stallation, Install the output shaft into the intermediate plate by pulling on the output shaft and tapping on the intermediate plate with a soft hammer.

23. Apply multi-purpose grease to the needle bearings and in-

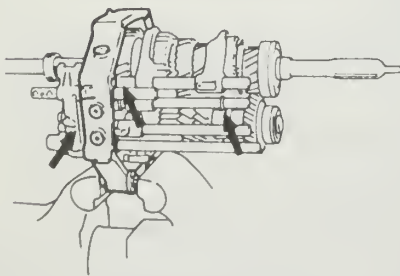
7 DRIVE TRAIN

2WD

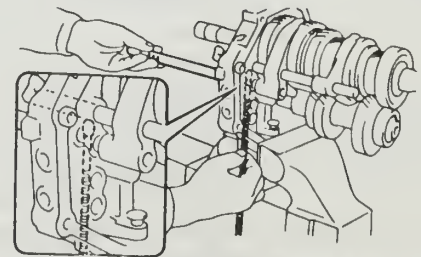
4WD



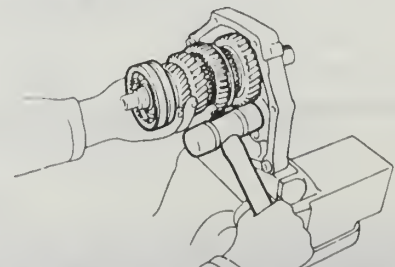
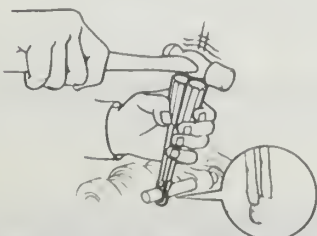
G-series transmission gear and shaft components



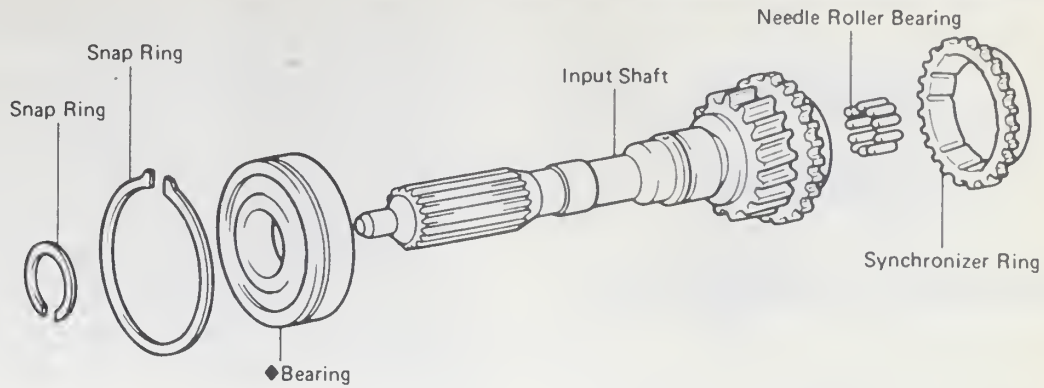
Use two screwdrivers and a hammer to remove snap rings from the shift fork shafts



Remove the Interlock pin before attempting to remove the shafts

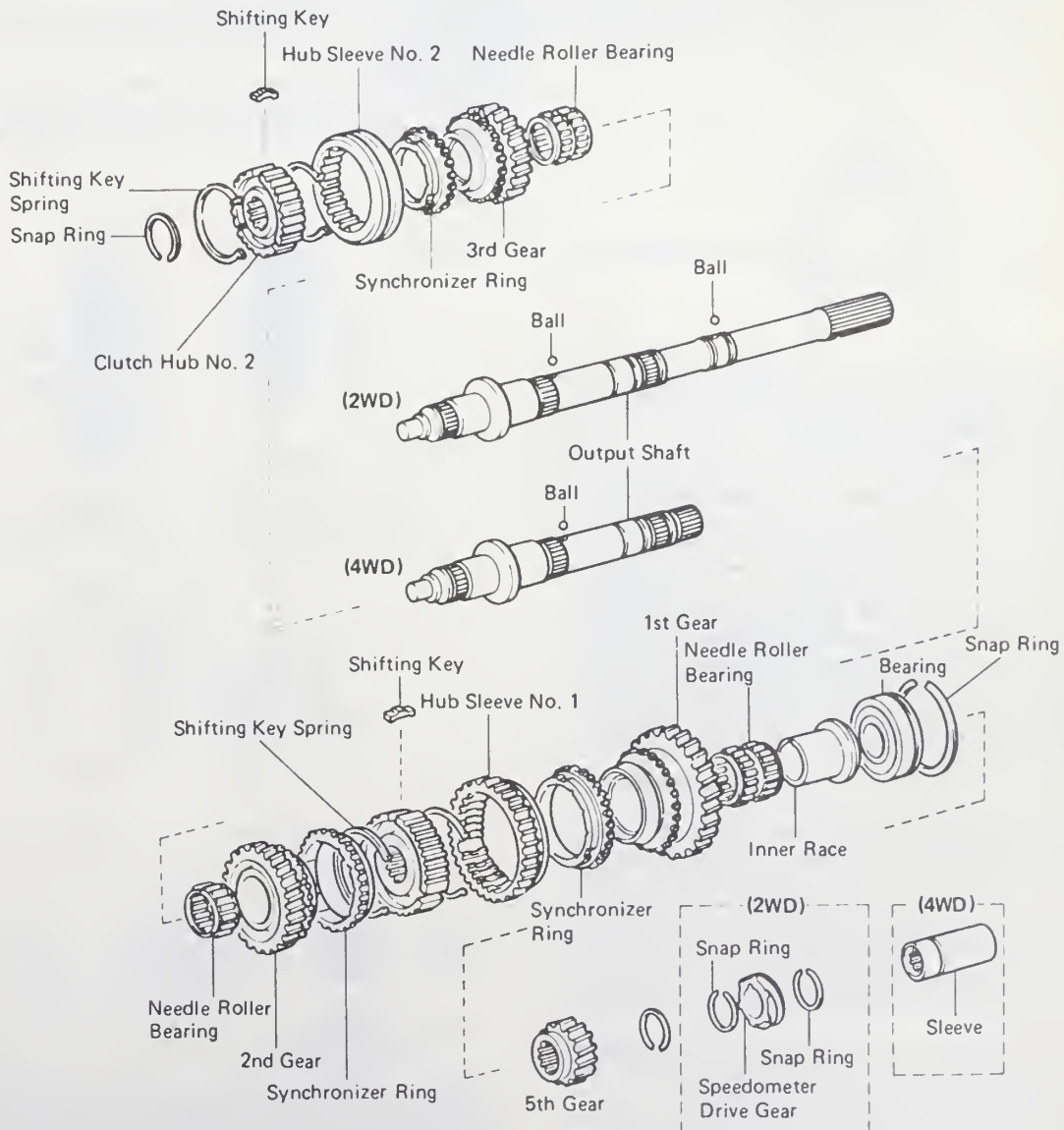


A gentle tap with a plastic mallet will free the output shaft from the Intermediate plated



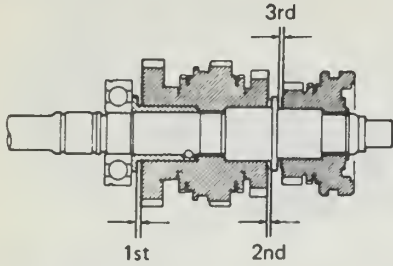
◆ Non-reusable part

Input shaft components

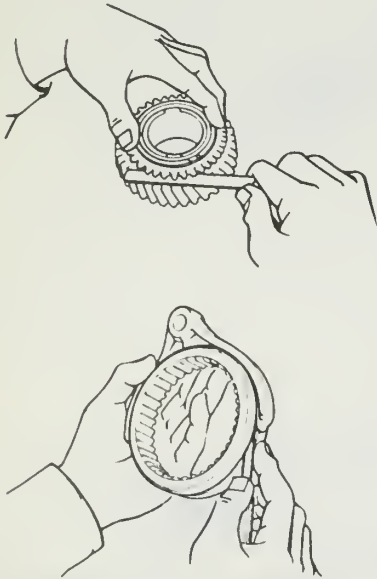


Output shaft components

7 DRIVE TRAIN



Inspect the thrust clearance for each gear



Inspecting the synchronizer clearance (above) and the shift fork-to-sleeve clearance

stall them in position on the input shaft. Install the input shaft to the output shaft with the synchronizer ring slots aligned with the shifting keys.

24. Install the countershaft and bearing to the intermediate plate. Install the output shaft snapping flush with the intermediate plate. Install the rear bearing retainer on the intermediate plate. Tighten the retainers to 13 ft. lbs. Install the reverse shift arm bracket. Install the ball and spacer on the countershaft and install the 5th gear with hub and needle bearings. Install the synchronizer assembly with the ring slots aligned with the shifting keys. Engage the gear and install the locknut. Torque the locknut to 87 ft. lbs. and stake the locknut. Disengage the gears. Check 5th gear thrust clearance.

25. Install the reverse shift arm to the pivot of the reverse shift arm bracket.

26. Install the reverse idler gear and shaft. Align the reverse shift arm shoe with the reverse idler gear groove and insert the reverse idler gear shaft into the intermediate plate. Install the gear shaft stopper and tighten the retaining bolt to 13 ft. lbs.

27. Position No. 1 and No. 2 shift forks into the grooves of their respective hub sleeves and install the No. 2 fork shaft through the forks and intermediate plate. Apply multi-purpose grease to the interlock pins and install the pins into the forks and intermediate plate.

28. Install the interlock pin in No. 1 shift shaft hole. Install the shift shaft through fork No. 1 and the intermediate plate. Install the interlock pin into the intermediate plate.

29. Install the interlock pin to the head of shift shaft No. 3. Install the shaft through the reverse shift arm and the intermediate plate.

30. Install the reverse shift head into fork shaft No. 5. Install fork shaft No. 5 to the intermediate plate and put the reverse shift head onto shift fork shaft No. 3.

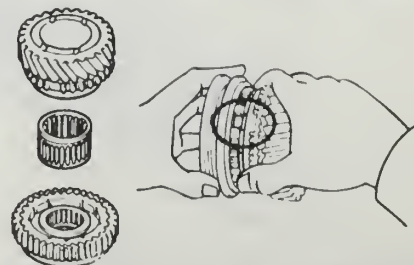
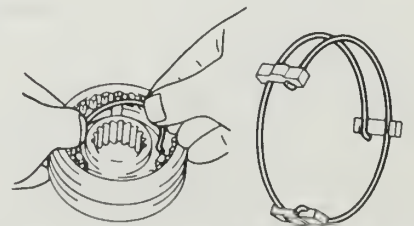
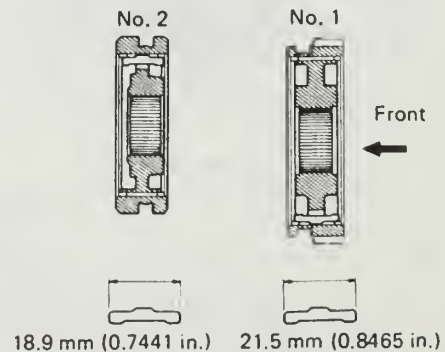
31. Install the locking ball into the reverse shift head hole. Shift the No. 3 synchronizer hub sleeve to the 5th speed position. Place shift fork No. 3 into the groove of hub sleeve No. 3 and install fork shaft No. 4 to shift fork No. 4 and the reverse shift arm. Install the locking ball into the intermediate plate and insert fork shaft No. 4 to the intermediate plate.

32. Shift fork shaft No. 1 to the 1st speed position. Forks No. 2, No. 3, No. 4 and No. 5 should not move. Install the slotted retainer spring pins into each shift fork, reverse shift arm and reverse shift head. Install the two fork shaft E-rings. Apply sealer to the locking ball cover screw plugs. Install the locking balls, springs and screw plugs with a Torx® socket and tighten to 14 ft. lbs. The short spring goes in the bottom of the intermediate plate.

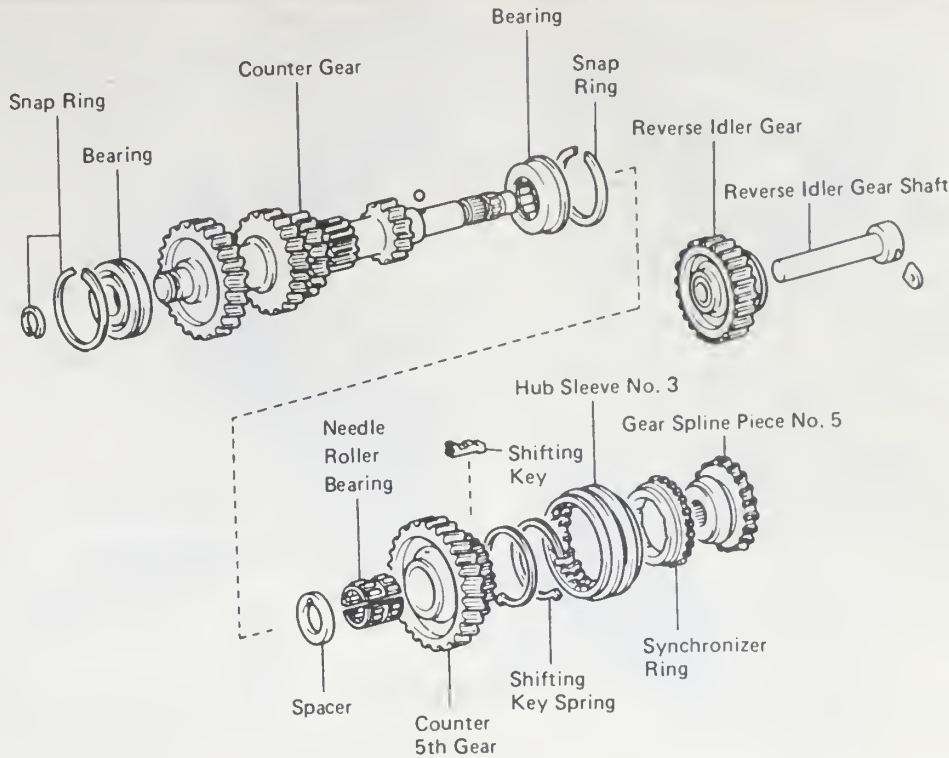
33. Mount the intermediate plate and gear assemblies to the transmission. Align each bearing outer race, each fork end and reverse idler shaft with the case installation holes, tap with a plastic hammer if necessary to help with alignment. Install the two bearing snaprings.

34. Install the front bearing retainer with a new gasket after applying sealer to the mounting bolts. Tighten the bolts to 12 ft. lbs.

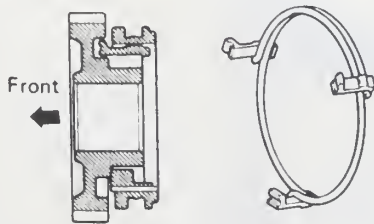
35. Install a new gasket on the intermediate plate. Install the transfer adapter and eight mounting bolts, torque the bolts to 27 ft. lbs. Insert the shift lever housing to the transfer adapter



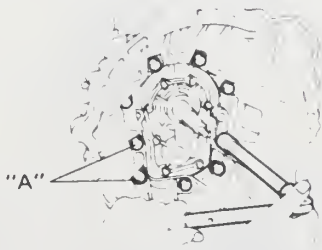
Correct assembly of the clutch hubs into the sleeve. Note that the spring ends are not aligned and that the ring slots are aligned with the shifting keys



Counter shaft and reverse idler gear assembly



Correct assembly of the No. hub sleeve



The bolts "A" must be coated with sealer before installation

39. Install the clutch housing and torque the bolts to 27 ft. lbs. The two bolts at the lower left of the pattern ("7 and 8 o'clock" positions) should be coated with liquid sealer before installation. Install the shift lever retainer and new gasket. Tighten to 13 ft. lbs.

40. Install the backup light switch (27 ft. lbs.). Install the release fork and bearing and install the transmission.

R-SERIES

1. Remove the release fork and bearing.
2. Remove the backup light switch.
3. Remove the shift lever retainer and restrictor pins.
4. Remove the clutch housing from the transmission case.
5. Using a Torx® socket wrench, remove the screw plug from the transfer case adaptor (4WD) or the extension housing (2WD). When the plug is removed, use a magnetic finger tool to remove the spring and ball.
6. On 4WD models, remove the shift lever housing set bolt and then remove the 10 transfer adaptor-to-transmission mounting bolts. Lightly tap the transfer adaptor with a rubber mallet until the shift lever housing can be removed along with the shift and select levers.
7. On 2WD models, remove the 10 extension housing-to-transmission case mounting bolts and then remove the shift lever housing set bolt. Lightly tap the extension housing with a rubber mallet until the shift lever housing can be removed along with the shift and select levers.
8. Remove the 8 mounting bolts and then tap out the front bearing retainer.
9. Using snapping pliers, remove the 2 bearing snaprings.
10. Use a brass drift and a hammer to tap off the transmission case and then remove the case from the intermediate plate.
11. Remove the magnet from the intermediate plate.

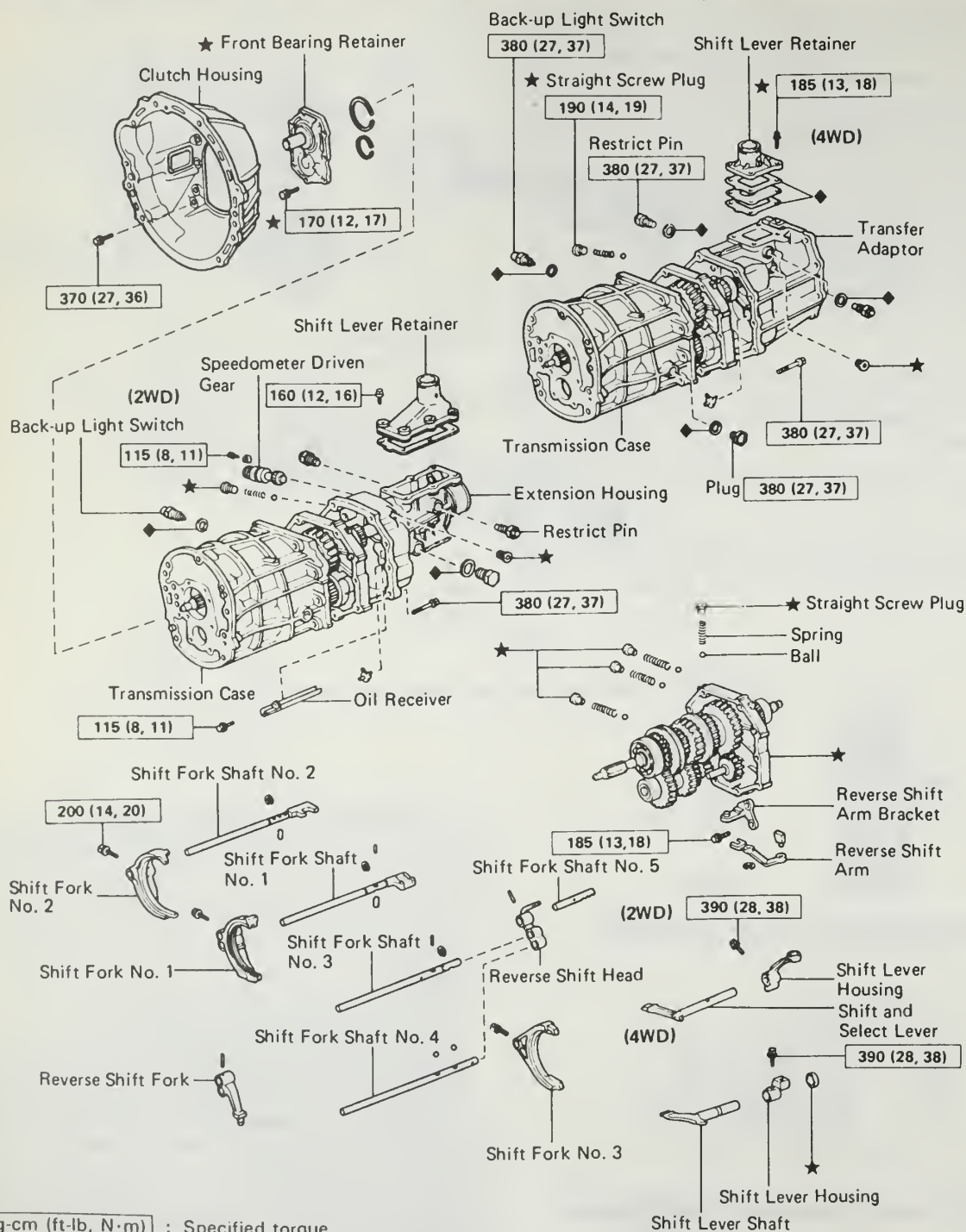
and connect the shift fork shafts. Insert the shift lever shaft to the transfer adapter and shift lever housing. Install and torque the shift lever housing bolt, torque to 28 ft. lbs. Install the front Torx® plug cover, tighten to 27 ft. lbs.

36. Install the side locking ball, spring and screw plug. Apply sealer to the plug before installation, torque to 14 ft. lbs.

37. After installing the extension housing or transfer adapter, check to see that the input and output shafts rotate smoothly.

38. Install the restrict pin on the reverse gear/5th gear side. Install the other restrict pin and torque both to 20 ft. lbs.

7 DRIVE TRAIN



R-series transmissions unit components

12. Mount the intermediate plate assembly in a vise by installing 2 clutch housing bolts with suitable plate washers and nuts. Install the plate washers in the reverse direction of normal use. Increase or decrease the amount of washers so that the bolt tips and nut tip surfaces are in alignment.

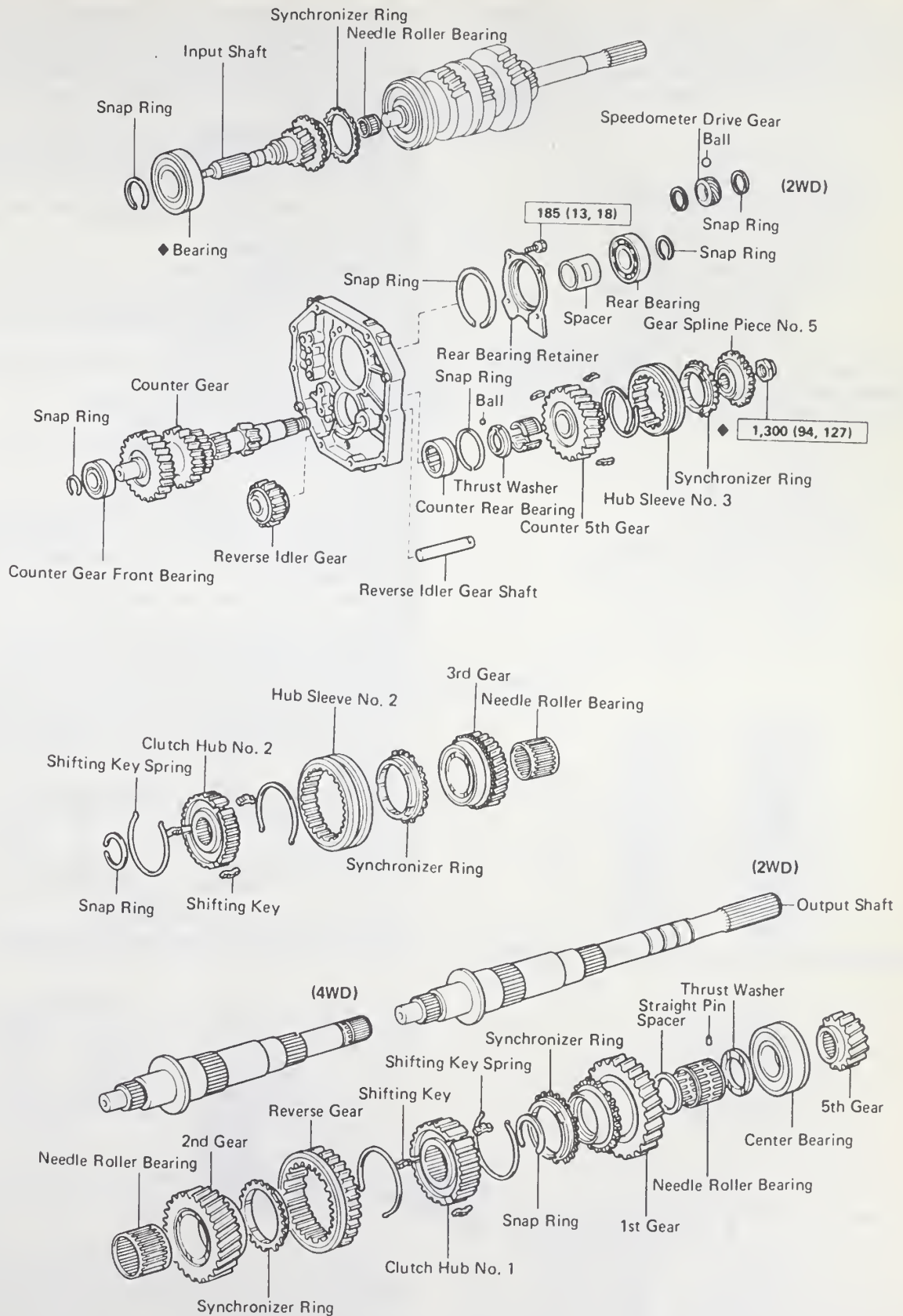
13. With a Torx® socket wrench, remove the 4 plugs on the

side of the intermediate plate. Remove the springs and balls with a magnetic finger.

14. Remove the set bolts from the shift fork shafts.

15. Remove the 3 snaprings from the ends of the shift fork shafts and then drive out the 2 pins using a punch.

16. Slide the No. 5 shift fork shaft from the intermediate plate.

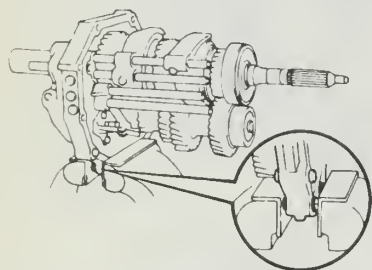


R-series transmissions gear and shaft components

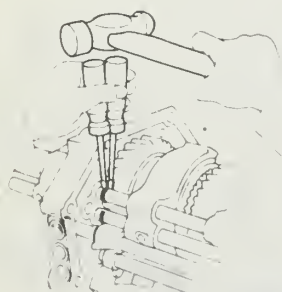
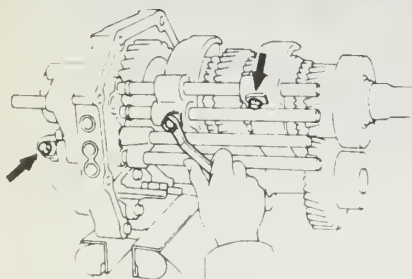
7 DRIVE TRAIN

17. Pull the No. 2 fork shaft from the plate and then remove the No. 2 shift fork itself. Use a magnet to remove the interlock pins from the shaft hole and intermediate plate.

18. Pull the No. 1 fork shaft from the plate. Use a magnet to remove the interlock pins from the shaft hole and intermediate plate.



Use clutch housing bolts in the bottom of the intermediate plate to take the force of the vise; do NOT clamp the vise against the plate



Removing the shift fork set bolts and snap rings

19. Pull the No. 3 fork shaft from the plate and then remove the No. 1 shift fork. Use a magnet to remove the interlock pins and locking ball from the shaft hole and intermediate plate.

20. Pull the No. 4 fork shaft from the plate and then remove the reverse shift head and locking ball. Remove the No. 3 shift fork.

21. Remove the reverse shift arm from the shift arm bracket.

22. Remove the 2 bolts and lift out the shift arm bracket.

23. Use a 2-armed puller to remove the sleeve from the output shaft.

24. Tap out the snapping at the output shaft rear bearing and then remove the bearing.

25. Remove the spacer.

26. Check the thrust clearance at the counter 5th gear. It should be 0.10-0.35mm.

27. Engage the 5th gear double meshing and loosen the staked nut with a hammer and chisel. Remove the lock nut and then disengage the double meshing.

28. Remove the No. 5 gear spline and lift off the counter 5th gear with the No. 3 hub sleeve.

29. Remove the thrust washer and ball.

30. Remove the rear bearing retainer.

31. Remove the reverse idler gear and shaft toward the rear of the intermediate plate.

32. Remove the bearing snapping.

33. Remove the output shaft, counter gear and input shaft from the intermediate plate as a unit. Pull on the counter gear while tapping the intermediate plate with a rubber mallet at the same time. Remove the input shaft and needle roller bearing from the output shaft.

34. Remove the counter rear bearing from the intermediate plate.

35. Check the thrust clearance of each gear. 1st should be 0.10-0.45mm. 2nd and 3rd should be 0.10-0.25mm.

36. Press the 5th gear, center bearing, thrust washer and 1st gear off the shaft as an assembly. Remove the synchronizer ring, straight pin and needle roller bearing. Remove the spacer.

37. Tap out the snapping and then press off the No. 1 hub sleeve, synchronizer ring and 2nd gear. Remove the needle roller bearing.

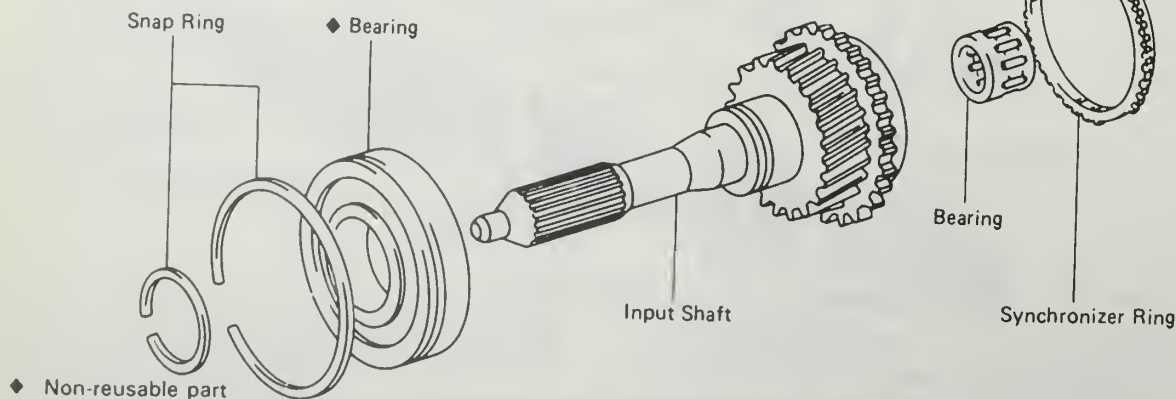
38. Tap out the snapping and then press off the No. 2 hub sleeve, synchronizer ring and 3rd gear. Remove the needle roller bearing.

To assemble:

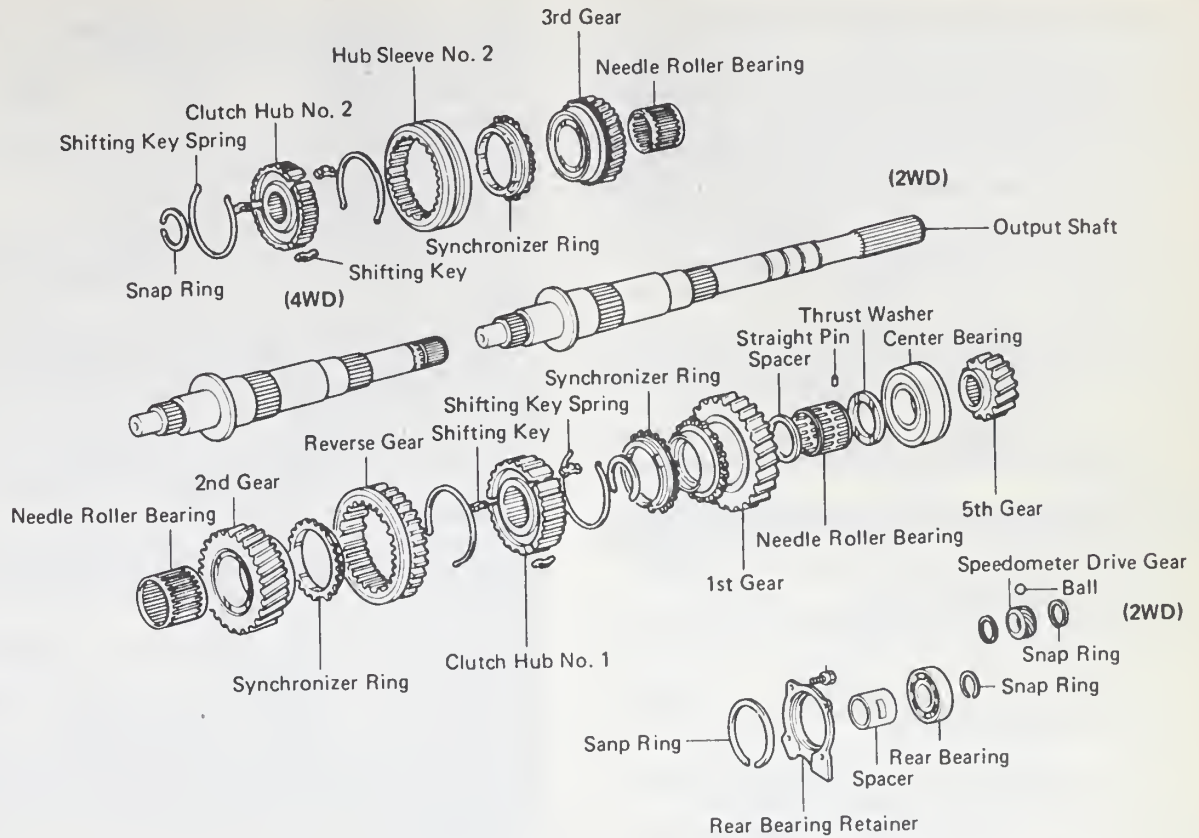
39. Install the clutch hub and shifting keys onto the hub sleeve. Position the shifting key springs under the keys.

CAUTION

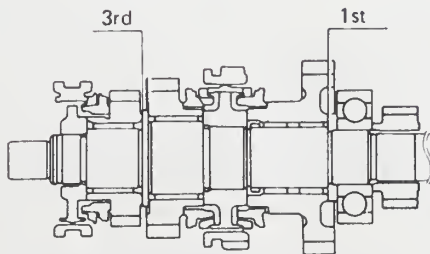
Make sure that the key spring end gaps are not aligned.



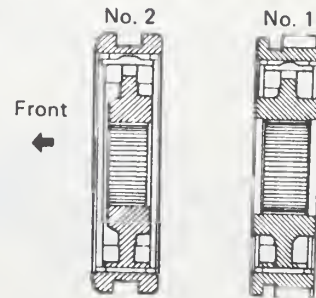
Input shaft components



Output shaft components



Check the thrust clearance of each gear



40. Coat the shaft and needle roller bearing with gear oil. Place the synchronizer ring on the gear so that the ring slots align with the shifting keys. Install the needle roller bearing in the 3rd gear and then press the 3rd gear and the No. 2 hub sleeve onto the shaft.

41. Install a snapping that will allow minimal axial play.

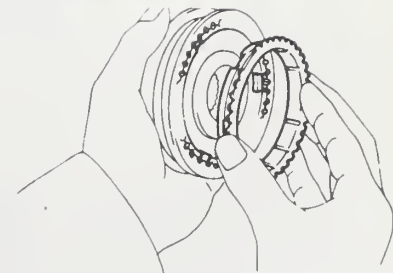
42. Check the 3rd gear thrust clearance. It should be 0.10-0.25mm.

43. Coat the shaft and needle roller bearing with gear oil. Place the synchronizer ring on the gear so that the ring slots align with the shifting keys. Install the needle roller bearing in the 2nd gear and then press the 2nd gear and the No. 1 hub sleeve onto the shaft.

44. Install a snapping that will allow minimal axial play.

45. Install the spacer on the output shaft. Coat the needle roller bearing with gear oil and assemble the 1st gear, synchronizer ring and needle roller bearing. Install the entire assembly on the output shaft so that the synchronizer ring slots are in alignment with the shifting keys.

46. Install the 1st gear thrust washer onto the output shaft so



Correct assembly of the hub sleeves and synchronizer ring

that the straight pin is in alignment with the 1st gear thrust washer.

47. Position the center bearing on the output shaft so that the snapping groove in the outer race is toward the rear and then press it onto the shaft.

48. Check the thrust clearance on 1st and 2nd gears. 1st gear

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should be 0.10-0.45mm. 2nd gear should be 0.10-0.25mm.

49. Press the 5th gear onto the shaft.

50. Install the output shaft assembly into the intermediate plate. Press on the shaft assembly while tapping on the plate with a rubber mallet. Install the snapping.

51. Coat the needle roller bearing with gear oil and install in on the input shaft. Install the input shaft to the output shaft making sure that the synchronizer ring slots are in alignment with the shifting keys.

52. While holding the counter gear in the intermediate plate, press the counter rear bearing in with a rubber mallet.

53. Install the reverse shift arm bracket and tighten the bolts to 13 ft. lbs. (18 Nm).

54. Install the reverse shift arm onto the pivot in the bracket.

55. Align the reverse shift arm shoe with the reverse idler gear groove and insert the reverse idler gear shaft into the intermediate plate.

56. Position the rear bearing retainer so it aligns with the groove in the idler gear shaft and tighten the mounting bolts to 13 ft. lbs. (18 Nm).

57. Insert the shifting keys and the No. 3 hub sleeve onto the counter 5th gear. Be sure to position the shifting key springs under the shifting keys so that their end gaps are not aligned.

58. Install the ball and thrust washer.

59. Coat the needle roller bearings with gear oil and then install them along with the counter 5th gear and the No. 3 hub sleeve.

60. Install the synchronizer ring on the No. 5 gear spline. Press the gear spline onto the shaft so that the synchronizer ring slots align with the shifting keys.

NOTE: When installing the No. 5 gear spline, support the counter gear in front with a 3-5 lb. hammer.

61. Engage the gear double meshing and install the locknut.

Tighten it to 94 ft. lbs. (127 Nm). Stake the locknut with a chisel and then disengage the double meshing.

62. Check that the thrust clearance on the counter 5th gear is 0.10-0.35mm.

63. Install the spacer.

64. Press the rear bearing onto the output shaft. Install a new snapping so it allows minimal axial play.

65. Tap the sleeve onto the output shaft.

66. Position the No. 3 shift fork in the groove of the No. 3 hub sleeve. Install the No. 4 shift fork shaft to the No. 3 shift fork. Reverse the shift head and shift fork through the intermediate plate.

67. Install the locking ball into the intermediate plate. Install the interlocking pin through the hole in the shaft and then position the No. 1 shift fork into the groove in the No. 1 hub sleeve. Install the No. 3 fork shaft to the reverse shift fork and shift head through the plate.

68. Install the locking ball into the intermediate plate. Install the interlocking pin through the hole in the shaft and then position the No. 1 shift fork shaft to the No. 1 shift fork through the intermediate plate.

69. Install the interlock pin into the intermediate plate. Position the No. 2 shift fork into the groove in the No. 2 hub sleeve and then install the No. 2 fork shaft to the No. 1 and No. 2 shift forks through the intermediate plate.

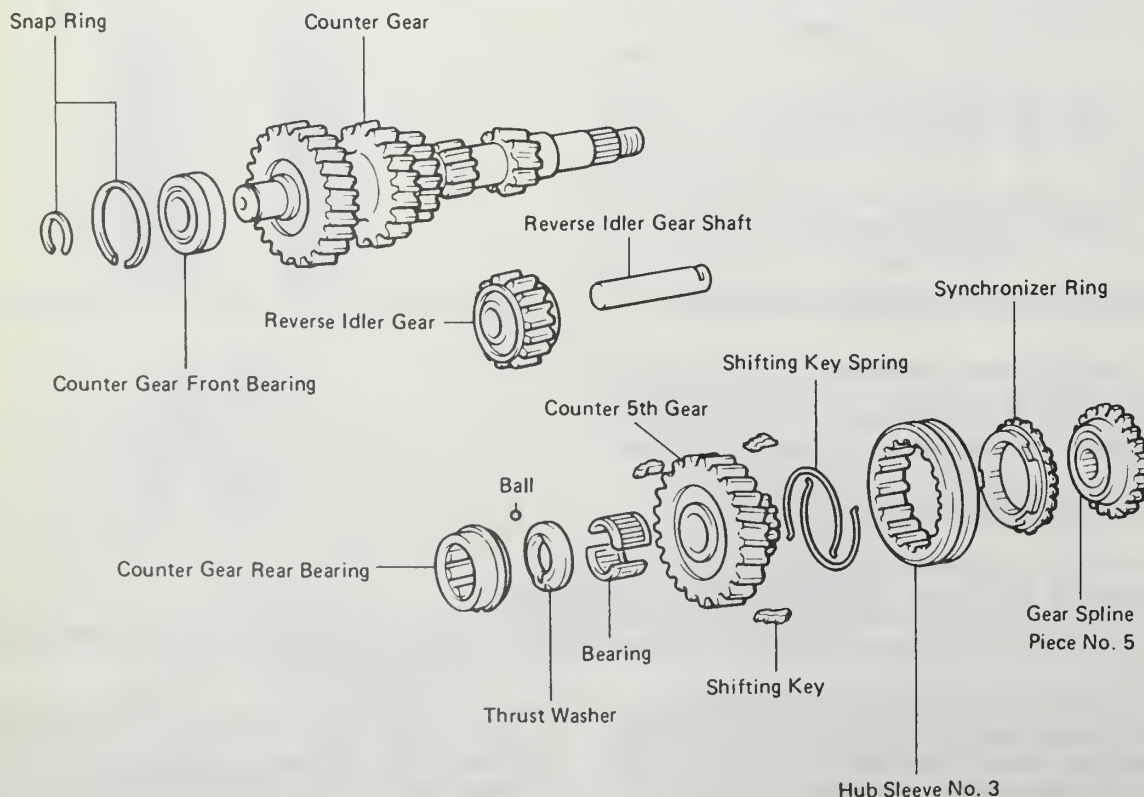
70. Install the No. 5 shift fork shaft to the reverse shift head through the intermediate plate.

71. Use a pin punch and hammer to drive the 2 slotted spring pins into the reverse shift head and shift fork.

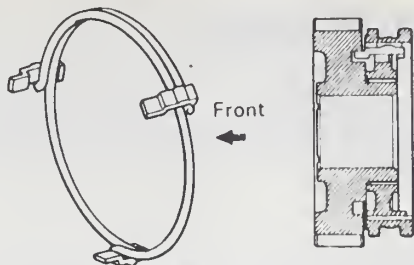
72. Shift the No. 1 shift fork shaft to the 1st speed position and check that the Nos. 2, 3, 4 and 5 shift fork shafts do not move.

73. Install 3 new snaprings to the end of the shift fork shafts.

74. Install the shift fork shaft set bolts and tighten them to 14 ft. lbs. (20 Nm).



Counter gear assembly and reverse idler gear



Correct assembly of hub sleeve No. 3 with keys and springs. Note the spring ends do not align

75. Apply liquid sealant to the intermediate plate plug hole threads and then install the 4 locking balls, springs and screw plugs. Tighten the screw plugs to 14 ft. lbs. (20 Nm).

76. Install the magnet to the intermediate plate.

77. Remove the intermediate plate assembly from the vise and take out the clutch housing screws.

78. Apply sealant to the transmission case and then make sure each bearing outer race, shift fork shaft end and reverse idler gear end are aligned with the case holes before installing the case. A rubber mallet may help persuade the case into position.

79. Install new input shaft bearing and counter gear front bearing snaprings.

80. Apply sealant to the front bearing retainer flange and the mounting bolt threads and then install the front bearing retainer. Tighten the bolts to 12 ft. lbs. (17 Nm).

81. On 4WD models, apply sealant to the transfer adaptor and install it to the intermediate plate. Tighten the mounting bolts to 27 ft. lbs. (37 Nm). Insert the shift and selector lever into the transfer adaptor. Connect the lever to the fork shaft and put in the shift lever housing. Align the No. 5 shift fork shaft to the transfer adaptor hole and press in the adaptor. Apply sealant to the plug threads and then install the shift lever housing bolt. Tighten it to 28 ft. lbs. (38 Nm).

82. On 2WD models, apply sealant to the extension housing flange. Insert the shift and selector lever into the extension housing. Connect the lever to the fork shaft and put in the shift lever housing. Align the No. 5 shift fork shaft to the extension housing hole and press in the housing. Install the housing mounting bolts and tighten to 27 ft. lbs. Install the shift lever housing bolt and tighten it to 28 ft. lbs. (38 Nm).

83. Apply sealant to the plug hole threads, install the locking ball and spring into the housing and tighten the plug to 14 ft. lbs. (19 Nm).

84. Check that the input and output shafts rotate smoothly. Check that shifting is smooth in all positions.

85. Install the restrict pin on the reverse/5th gear side. Install another pin and tighten to 27 ft. lbs. (37 Nm).

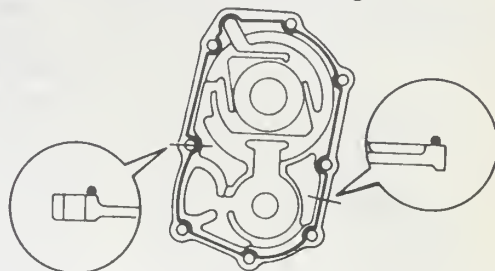
86. Install the clutch housing and tighten the mounting bolts to 27 ft. lbs. (37 Nm).

87. Install the shift lever retainer with a new gasket. Use sealant on the bolts and tighten to 13 ft. lbs. (18 Nm).

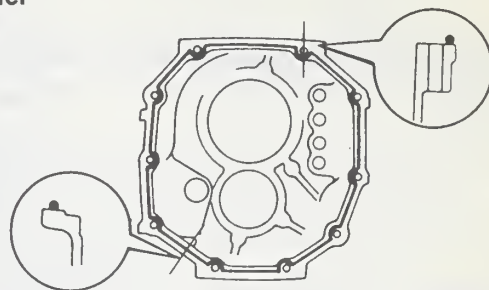
88. Install the backup light switch. Tighten to 27 ft. lbs. (37 Nm) on models with 4 cylinder engines and 33 ft. lbs. (44 Nm) on models with the V6.

89. Install the speedometer driven gear.

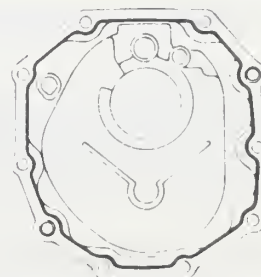
90. Install the release fork and bearing.



Correct application of sealant to the front bearing retainer



Apply a bead of liquid sealer to the transmission case



Sealant must be applied to the transfer adapter on 4WD vehicles

CLUTCH

CAUTION

The clutch driven disc contains asbestos which has been determined to be a cancer causing agent. Avoid inhaling any dust from any clutch surface! When cleaning clutch surfaces, use a commercially available brake cleaning fluid. NEVER clean clutch surfaces with compressed air.

Understanding the Clutch

The purpose of the clutch is to disconnect and connect engine power from the transmission. A vehicle at rest requires a lot of engine torque to get all that weight moving. An internal combustion engine does not develop a high starting torque (unlike

Troubleshooting Basic Clutch Problems

Problem	Cause
Excessive clutch noise	Throwout bearing noises are more audible at the lower end of pedal travel. The usual causes are: • Riding the clutch • Too little pedal free-play • Lack of bearing lubrication A bad clutch shaft pilot bearing will make a high pitched squeal, when the clutch is disengaged and the transmission is in gear or within the first 2" of pedal travel. The bearing must be replaced. Noise from the clutch linkage is a clicking or snapping that can be heard or felt as the pedal is moved completely up or down. This usually requires lubrication. Transmitted engine noises are amplified by the clutch housing and heard in the passenger compartment. They are usually the result of insufficient pedal free-play and can be changed by manipulating the clutch pedal.
Clutch slips (the car does not move as it should when the clutch is engaged)	This is usually most noticeable when pulling away from a standing start. A severe test is to start the engine, apply the brakes, shift into high gear and SLOWLY release the clutch pedal. A healthy clutch will stall the engine. If it slips it may be due to: • A worn pressure plate or clutch plate • Oil soaked clutch plate • Insufficient pedal free-play
Clutch drags or fails to release	The clutch disc and some transmission gears spin briefly after clutch disengagement. Under normal conditions in average temperatures, 3 seconds is maximum spin-time. Failure to release properly can be caused by: • Too light transmission lubricant or low lubricant level • Improperly adjusted clutch linkage
Low clutch life	Low clutch life is usually a result of poor driving habits or heavy duty use. Riding the clutch, pulling heavy loads, holding the car on a grade with the clutch instead of the brakes and rapid clutch engagement all contribute to low clutch life.

steam engines), so it must be allowed to operate without any load until it builds up enough force to move the car. (Torque increases with engine rpm.) The clutch allows the engine to build up torque by physically disconnecting the engine from the transmission, relieving the engine of any load or resistance.

The transfer of engine power to the transmission (the load) must be smooth and gradual; if it weren't, drive line components would wear out or break quickly. This smooth power transfer is made possible by gradually releasing the clutch pedal. The clutch disc and pressure plate are the connecting link between the engine and transmission. When the clutch pedal is released, the disc and plate contact each other (clutch engagement), physically joining the engine and transmission. When the pedal is pushed in, the disc and plate separate (the clutch is disengaged), disconnecting the engine from the transmission.

The clutch assembly consists of the flywheel, the clutch disc, the clutch pressure plate, the throwout (release) bearing and fork, the actuating linkage and the pedal. The flywheel and clutch pressure plate are connected to the engine crankshaft and rotate with it. The clutch disc is located between the fly-

wheel and pressure plate, and splined to the transmission shaft. When the pressure plate clamps the clutch disc against the flywheel, power is transferred from the engine into the transmission.

There is a circular diaphragm spring within the pressure plate cover on the transmission side. In a relaxed state (when the clutch pedal is fully released), this spring is convex; that is, it is dished outward toward the transmission. The outer edges of the spring are secured to the pressure plate and are pivoted on rings; when the center of the spring is compressed by the throwout bearing, the outer edges bow outward and pull the pressure plate in the same direction - away from the clutch disc. This action separates the disc from the plate, disengaging the clutch and allowing the transmission to be shifted into another gear.

A clutch return spring attached to the clutch pedal arm permits full release of the pedal. Releasing the pedal pulls the throwout bearing away from the diaphragm spring resulting in a reversal of spring position. As bearing pressure is gradually released from the spring center, the outer edges of the spring bow

outward, pushing the pressure plate into closer contact with the clutch disc. As the disc and plate move closer together, friction between the two increases and slippage is reduced until, when full spring pressure is applied (by fully releasing the pedal), the speed of the disc and plate are the same. All slipping is stopped, creating a direct connection between the plate and disc. The clutch disc is now rotating with the pressure plate at engine speed and, because it is splined to the transmission shaft, the shaft now turns at engine speed.

The diaphragm spring clutches are available in two different designs: flat diaphragm springs or bent spring. The bent fingers are bent back to create a centrifugal boost ensuring quick re-engagement at higher engine speeds. This design enables pressure plate load to increase as the clutch disc wears and makes low pedal effort possible even with a heavy-duty clutch. The throwout bearing used with the bent finger design is 32mm long and is shorter than the bearing used with the flat finger design. These bearings are not interchangeable. If the longer bearing is used with the bent finger clutch, free-pedal travel will not exist. This results in clutch slippage and rapid wear.

The transmission varies the gear ratio between the engine and rear wheels. It can be shifted to change engine speed as driving conditions and loads change. The transmission allows disengaging and reversing power from the engine to the wheels.

Adjustments

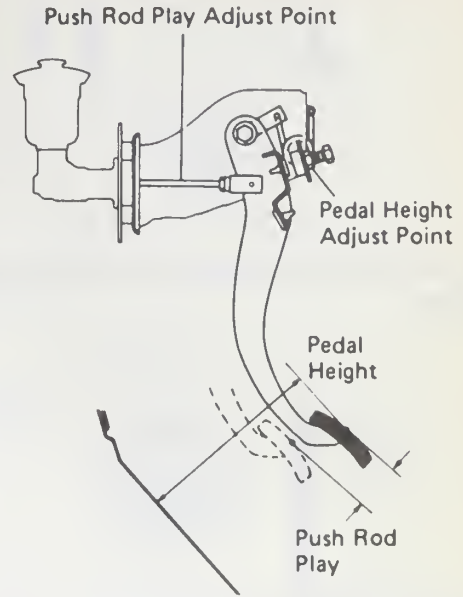
CLUTCH PEDAL HEIGHT ADJUSTMENT

The pedal height measurement is gauged from the angle section of the floorboard to the center of the clutch pedal pad. If necessary, adjust the pedal height by loosening the locknut and turning the pedal stop bolt which is located above the pedal toward the driver's seat. Tighten the locknut after the adjustment.

Correct pedal height from the floor pan sheet (not the carpet) is 154.5mm (6.0827 in.) for 2WD vehicles and 151.5mm (5.9646 in.) for 4WD.

CLUTCH PEDAL PUSHROD PLAY ADJUSTMENT

The pedal pushrod play is the distance between the clutch master cylinder piston and the pedal pushrod located above the



Clutch pedal height and free play is easily adjusted at the pedal

pedal towards the firewall. Since it is nearly impossible to measure this distance at the source, it must be measured at the pedal pad. Correct free play is 5–15mm (0.2–0.6 in.).

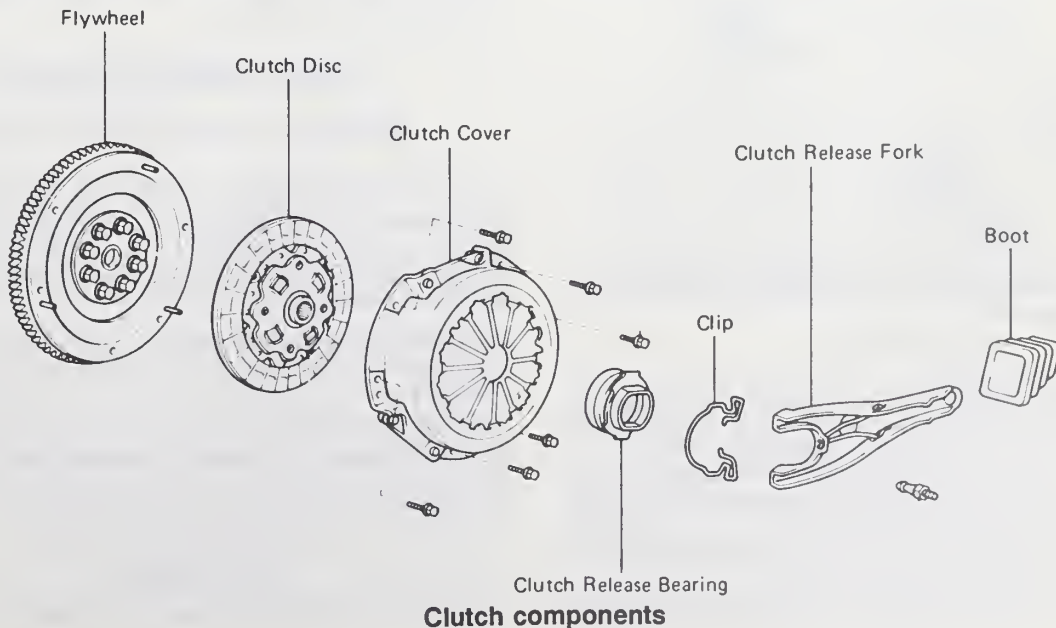
If necessary, adjust the pedal play by loosening the pedal pushrod locknut and turning the pushrod. Tighten the locknut after the adjustment.

Clutch Disc and Pressure Plate

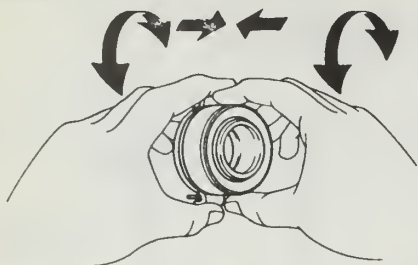
REMOVAL AND INSTALLATION

CAUTION

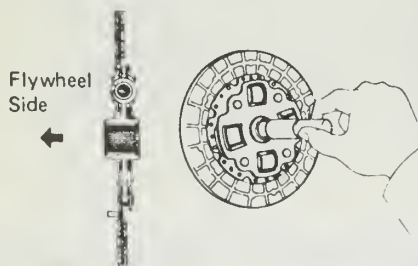
The clutch driven disc contains asbestos, which has been determined to be a cancer causing agent. Avoid inhaling any dust from any clutch surface! When cleaning clutch surfaces, use a commercially available brake cleaning fluid. Never clean clutch surfaces with compressed air.



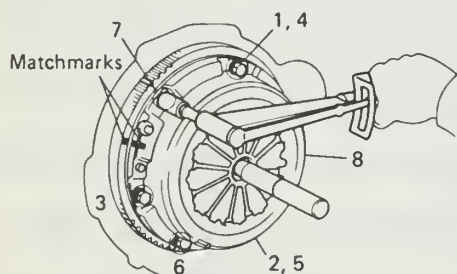
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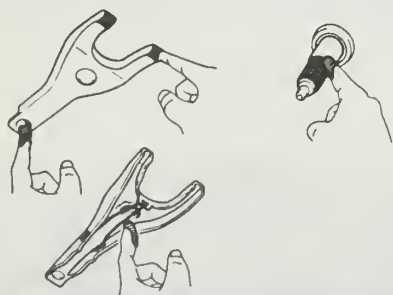
Check the throw-out bearing for any resistance or grinding



Correct positioning of the clutch disc at installation



Note the use of clutch aligning tool to center all components. Tighten the bolts in the order shown in several passes



Areas to be greased before installation of the release fork and transmission

1. Remove the transmission.
2. Stamp or chalk matchmarks on the clutch cover (pressure plate) and flywheel, indicating their relationship. The assembly must be reinstalled in the exact same position.
3. Loosen the clutch cover-to-flywheel retaining bolts one turn at a time in a criss-cross pattern. The pressure on the clutch disc must be released GRADUALLY.
4. Remove the clutch cover-to-flywheel bolts. Remove the clutch cover and the clutch disc.
5. If the clutch release bearing is to be replaced, do so at this time as follows:

a. Remove the bearing retaining clip(s) and remove the bearing and hub.

b. Remove the release fork and the boot.

c. The bearing is press fit to the hub. Turn the bearing by hand while placing it under some pressure; check for freedom of motion and lack of grinding or resistance. The bearing is permanently lubricated and cannot be disassembled or greased.

d. Clean all parts; lightly grease the input shaft splines and all of the contact points.

e. Install the bearing/hub assembly, fork, boot, and retaining clip(s) in their original locations.

6. Inspect the flywheel surface for cracks, heat scoring (blue marks), and warpage. If oil is present on the flywheel surface, this indicates that either the engine rear oil seal or the transmission front oil seal is leaking. If necessary, replace the seal(s). If in doubt concerning the condition of the flywheel, consult an automotive machine shop.

7. Before installing any new parts, make sure that they are clean. During installation, do not get grease or oil on any of the components, as this will shorten clutch life considerably. Grease or fingerprints may be cleaned with an evaporative cleaner such as used on brake linings.

8. Position the clutch disc against the flywheel. The long side of the splined section faces the flywheel.

9. Install the clutch cover over the disc and install the bolts loosely. Align the matchmarks made during Step 2. If a new or rebuilt clutch cover assembly is installed, use the matchmark on the old cover assembly as a reference.

NOTE: Whenever the clutch disc is replaced, replacement of the pressure plate (clutch cover) and release bearing is highly recommended.

10. Align the clutch disc with the flywheel using a clutch aligning tool. These handy tools are available in most auto stores at a reasonable price. Do NOT attempt to align the clutch disc by eye; use an alignment tool.

11. With the clutch aligning tool installed, tighten the clutch cover bolts gradually in a star pattern, as is done with lug nuts. Final tighten the bolts to 14 ft. lbs. (19 Nm).

12. Apply molybdenum disulfide grease or multi-purpose grease to the release fork contact points, the pivot and the clutch disc splines. Install the boot, fork, and bearing on the transmission input shaft.

13. Install the transmission.

Clutch Master Cylinder

REMOVAL AND INSTALLATION

1. Remove the clip and pin at the top of the clutch pedal; disconnect the master cylinder pushrod from the clutch pedal.

2. Remove the hydraulic line from the master cylinder, being careful not to damage the fitting.

3. Remove the two bolts holding the master cylinder to the engine compartment.

WARNING: Brake fluid dissolves paint. Do not allow it to drip onto the body when removing the master cylinder.

4. Install the master cylinder. Partially tighten the hydraulic line and then tighten the cylinder mounting bolts to 9 ft. lbs. (13 Nm).

5. Connect the pushrod to the clutch pedal.

6. Bleed the system. Adjust the clutch pedal.

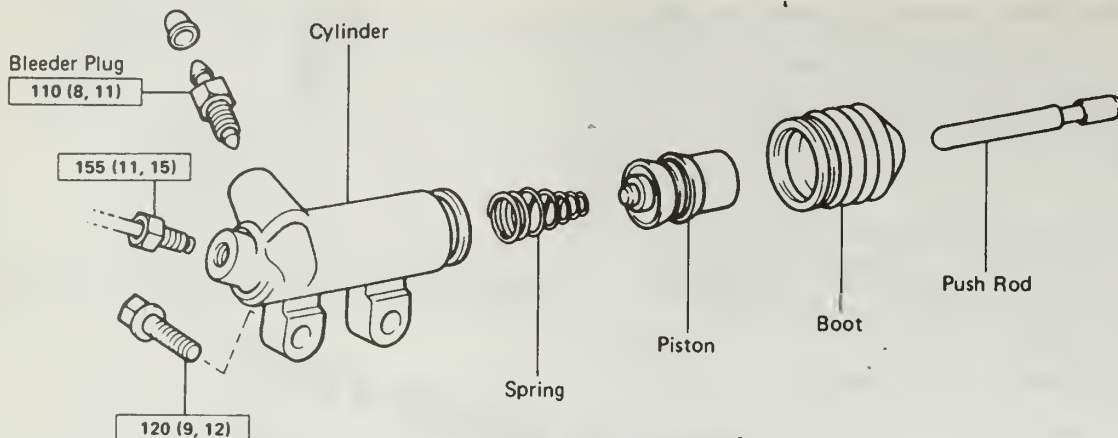
OVERHAUL

1. Use a pin punch and a hammer to drive out the slotted

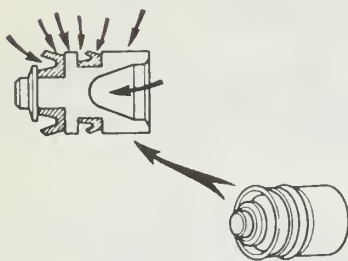


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7 DRIVE TRAIN



Clutch release cylinder components



Coat the piston with grease in the locations shown

Hydraulic System Bleeding

This operation must be performed any time the clutch master or release cylinder has been removed or if any of the hydraulic lines have been opened.

WARNING: Do not spill brake fluid on the bodywork of the vehicle; it will destroy the paint. If fluid is spilled, immediately wash the surface with plenty of clean water.

1. Fill the master cylinder reservoir with brake fluid.
2. Remove the cap on the bleeder screw on the clutch release cylinder. Install a clear vinyl hose on the fitting; place the other end submerged in a clear glass jar partially filled with brake fluid.
3. Have an assistant pump the clutch pedal slowly several times. After several pumps, hold the pedal down and open the bleeder, allowing fluid to flow into the jar. Close the bleeder valve almost immediately after opening it. Release the pedal only after the bleeder is closed.
4. Repeat the process until the fluid in the hose contains no air bubbles.
5. Fill the clutch master cylinder reservoir to the correct level with brake fluid.
6. Check the system for leaks.

AUTOMATIC TRANSMISSION

Understanding Automatic Transmissions

The automatic transmission allows engine torque and power to be transmitted to the rear wheels within a narrow range of engine operating speeds. The transmission will allow the engine to turn fast enough to produce plenty of power and torque at very low speeds, while keeping it at a sensible rpm at high vehicle speeds. The transmission performs this job entirely without driver assistance.

The transmission uses a light fluid as the medium for the transmission of power. This fluid also works in the operation of various hydraulic control circuits and as a lubricant. Because the transmission fluid performs all of these three functions,

trouble within the unit can easily travel from one part to another. For this reason, and because of the complexity and unusual operating principles of the transmission, a very sound understanding of the basic principles of operation will simplify troubleshooting.

TORQUE CONVERTER

The torque converter replaces the conventional clutch. It has three functions:

1. It allows the engine to idle with the vehicle at a standstill, even with the transmission in gear.
2. It allows the transmission to shift from range to range smoothly, without requiring that the driver close the throttle during the shift.

3. It multiplies engine torque more as vehicle speed drops and throttle opening is increased. This has the effect of making the transmission more responsive and reduces the amount of shifting required.

The torque converter is a metal case which is shaped like a sphere that has been flattened on opposite sides. It is bolted to the rear end of the engine's crankshaft. Generally, the entire metal case rotates at engine speed and serves as the engine's flywheel.

The case contains three sets of blades. One set is attached directly to the case. This set forms the torus or pump. Another set is directly connected to the output shaft, and forms the turbine. The third set is mounted on a hub which, in turn, is mounted on a stationary shaft through a one-way clutch. This third set is known as the stator.

A pump, which is driven by the converter hub at engine speed, keeps the torque converter full of transmission fluid at all times. Fluid flows continuously through the unit to provide cooling.

Under low speed acceleration, the torque converter functions as follows:

The torus is turning faster than the turbine. It picks up fluid at the center of the converter and, through centrifugal force, slings it outward. Since the outer edge of the converter moves faster than the portions at the center, the fluid picks up speed.

The fluid then enters the outer edge of the turbine blades. It then travels back toward the center of the converter case along the turbine blades. In impinging upon the turbine blades, the fluid loses the energy picked up in the torus.

If the fluid were now to immediately be returned directly into the torus, both halves of the converter would have to turn at approximately the same speed at all times, and torque input and output would both be the same.

In flowing through the torus and turbine, the fluid picks up two types of flow, or flow in two separate directions. It flows through the turbine blades, and it spins with the engine. The stator, whose blades are stationary when the vehicle is being accelerated at low speeds, converts one type of flow into another. Instead of allowing the fluid to flow straight back into the torus, the stator's curved blades turn the fluid almost 90° toward the direction of rotation of the engine. Thus the fluid does not flow as fast toward the torus, but is already spinning when the torus picks it up. This has the effect of allowing the torus to turn much faster than the turbine. This difference in speed may be compared to the difference in speed between the smaller and larger gears in any gear train. The result is that engine power output is higher, and engine torque is multiplied.

As the speed of the turbine increases, the fluid spins faster and faster in the direction of engine rotation. As a result, the ability of the stator to redirect the fluid flow is reduced. Under cruising conditions, the stator is eventually forced to rotate on its one-way clutch in the direction of engine rotation. Under these conditions, the torque converter begins to behave almost like a solid shaft, with the torus and turbine speeds being almost equal.

PLANETARY GEARBOX

The ability of the torque converter to multiply engine torque is limited. Also, the unit tends to be more efficient when the turbine is rotating at relatively high speeds. Therefore, a planetary gearbox is used to carry the power output of the turbine to the driveshaft.

Planetary gears function very similarly to conventional transmission gears. However, their construction is different in that three elements make up one gear system, and all three elements are different from one another. The three elements are: an outer gear that is shaped like a hoop, with teeth cut into the inner surface; a sun gear, mounted on a shaft and located at the very center of the outer gear; and a set of three planet gears, held by pins in a ring-like planet carrier, meshing with both the sun

gear and the outer gear. Either the outer gear or the sun gear may be held stationary, providing more than one possible torque multiplication factor for each set of gears. Also, if all three gears are forced to rotate at the same speed, the gearset forms, in effect, a solid shaft.

SERVOs AND ACCUMULATORS

The servos are hydraulic pistons and cylinders. They resemble the hydraulic actuators used on many familiar machines, such as bulldozers. Hydraulic fluid enters the cylinder, under pressure, and forces the piston to move to engage the band or clutches.

The accumulators are used to cushion the engagement of the servos. The transmission fluid must pass through the accumulator on the way to the servo. The accumulator housing contains a thin piston which is sprung away from the discharge passage of the accumulator. When fluid passes through the accumulator on the way to the servo, it must move the piston against spring pressure, and this action smooths out the action of the servo.

HYDRAULIC CONTROL SYSTEM

The hydraulic pressure used to operate the servos comes from the main transmission oil pump. This fluid is channeled to the various servos through the shift valves. There is generally a manual shift valve which is operated by the transmission selector lever and an automatic shift valve for each automatic upshift the transmission provides: i.e., 2 speed automatics have a low/high shift valve, while 3 speeds have a 1-2 valve, and a 2-3 valve.

There are two pressures which effect the operation of these valves. One is the governor pressure which is affected by vehicle speed. The other is the modulator pressure which is affected by intake manifold vacuum or throttle position. Governor pressure rises with an increase in vehicle speed, and modulator pressure rises as the throttle is opened wider. By responding to these two pressures, the shift valves cause the upshift points to be delayed with increased throttle opening to make the best use of the engine's power output.

Most transmissions also make use of an auxiliary circuit for downshifting. This circuit may be actuated by the throttle linkage or the vacuum line which actuates the modulator, or by a cable or solenoid. It applies pressure to a special downshift surface on the shift valve or valves.

The transmission modulator also governs the line pressure, used to actuate the servos. In this way, the clutches and bands will be actuated with a force matching the torque output of the engine.

Application

The A43D is a fully automatic 2WD, four speed transmission with electrically engaged overdrive. It was first offered as an option on 1981 models and is available through the current model year. The A44F is the 4WD application found in 1990 and 1991 4Runners.

The A340E, A340, and A340H are also fully automatic transmissions, but rely on electronic computer control rather than the conventional reliance on internal oil pressures. Because of the electronic controls, these units are referred to as ECT or Electronically Controlled Transmissions.

The A340E contains a lockup torque converter and is coupled to the 3VZ-E engine. The A340F employs a mechanically controlled transfer unit for 4WD applications, while the A340H, also used in 4WD vehicles, is coupled to an electrically controlled transfer.

Land Cruisers are equipped with an A440F transmission which is similar to the A-43D. It contains a lockup torque converter and is coupled to a 2-speed transfer unit.

7 DRIVE TRAIN

Troubleshooting Basic Automatic Transmission Problems

Problem	Cause	Solution
Fluid leakage	• Defective pan gasket • Loose filler tube • Loose extension housing to transmission case • Converter housing area leakage	• Replace gasket or tighten pan bolts • Tighten tube nut • Tighten bolts • Have transmission checked professionally
Fluid flows out the oil filler tube	• High fluid level • Breather vent clogged • Clogged oil filter or screen • Internal fluid leakage	• Check and correct fluid level • Open breather vent • Replace filter or clean screen (change fluid also) • Have transmission checked professionally
Transmission overheats (this is usually accompanied by a strong burned odor to the fluid)	• Low fluid level • Fluid cooler lines clogged • Heavy pulling or hauling with insufficient cooling • Faulty oil pump, internal slippage	• Check and correct fluid level • Drain and refill transmission. If this doesn't cure the problem, have cooler lines cleared or replaced. • Install a transmission oil cooler • Have transmission checked professionally
Buzzing or whining noise	• Low fluid level • Defective torque converter, scored gears	• Check and correct fluid level • Have transmission checked professionally
No forward or reverse gears or slippage in one or more gears	• Low fluid level • Defective vacuum or linkage controls, internal clutch or band failure	• Check and correct fluid level • Have unit checked professionally
Delayed or erratic shift	• Low fluid level • Broken vacuum lines • Internal malfunction	• Check and correct fluid level • Repair or replace lines • Have transmission checked professionally

Lockup Torque Converter Service Diagnosis

Problem	Cause	Solution
No lockup	• Faulty oil pump • Sticking governor valve • Valve body malfunction (a) Stuck switch valve (b) Stuck lockup valve (c) Stuck fail-safe valve • Failed locking clutch • Leaking turbine hub seal • Faulty input shaft or seal ring	• Replace oil pump • Repair or replace as necessary • Repair or replace valve body or its internal components as necessary • Replace torque converter • Replace torque converter • Repair or replace as necessary

Lockup Torque Converter Service Diagnosis

Problem	Cause	Solution
Will not unlock	• Sticking governor valve • Valve body malfunction (a) Stuck switch valve (b) Stuck lockup valve (c) Stuck fail-safe valve	• Repair or replace as necessary • Repair or replace valve body or its internal components as necessary
Stays locked up at too low a speed in direct	• Sticking governor valve • Valve body malfunction (a) Stuck switch valve (b) Stuck lockup valve (c) Stuck fail-safe valve	• Repair or replace as necessary • Repair or replace valve body or its internal components as necessary
Locks up or drags in low or second	• Faulty oil pump • Valve body malfunction (a) Stuck switch valve (b) Stuck fail-safe valve	• Replace oil pump • Repair or replace valve body or its internal components as necessary
Sluggish or stalls in reverse	• Faulty oil pump • Plugged cooler, cooler lines or fittings • Valve body malfunction (a) Stuck switch valve (b) Faulty input shaft or seal ring	• Replace oil pump as necessary • Flush or replace cooler and flush lines and fittings • Repair or replace valve body or its internal components as necessary
Loud chatter during lockup engagement (cold)	• Faulty torque converter • Failed locking clutch • Leaking turbine hub seal	• Replace torque converter • Replace torque converter • Replace torque converter
Vibration or shudder during lockup engagement	• Faulty oil pump • Valve body malfunction • Faulty torque converter • Engine needs tune-up	• Repair or replace oil pump as necessary • Repair or replace valve body or its internal components as necessary • Replace torque converter • Tune engine
Vibration after lockup engagement	• Faulty torque converter • Exhaust system strikes underbody • Engine needs tune-up • Throttle linkage misadjusted	• Replace torque converter • Align exhaust system • Tune engine • Adjust throttle linkage
Vibration when revved in neutral Overheating: oil blows out of dip stick tube or pump seal	• Torque converter out of balance • Plugged cooler, cooler lines or fittings • Stuck switch valve	• Replace torque converter • Flush or replace cooler and flush lines and fittings • Repair switch valve in valve body or replace valve body

7 DRIVE TRAIN

Lockup Torque Converter Service Diagnosis

Problem	Cause	Solution
Shudder after lockup engagement	• Faulty oil pump • Plugged cooler, cooler lines or fittings • Valve body malfunction • Faulty torque converter • Fail locking clutch • Exhaust system strikes underbody • Engine needs tune-up • Throttle linkage misadjusted	• Replace oil pump • Flush or replace cooler and flush lines and fittings • Repair or replace valve body or its internal components as necessary • Replace torque converter • Replace torque converter • Align exhaust system • Tune engine • Adjust throttle linkage

Transmission Fluid Indications

The appearance and odor of the transmission fluid can give valuable clues to the overall condition of the transmission. Always note the appearance of the fluid when you check the fluid level or change the fluid. Rub a small amount of fluid between your fingers to feel for grit and smell the fluid on the dipstick.

If the fluid appears:	It indicates:
Clear and red colored	• Normal operation
Discolored (extremely dark red or brownish) or smells burned	• Band or clutch pack failure, usually caused by an overheated transmission. Hauling very heavy loads with insufficient power or failure to change the fluid, often result in overheating. Do not confuse this appearance with newer fluids that have a darker red color and a strong odor (though not a burned odor).
Foamy or aerated (light in color and full of bubbles)	• The level is too high (gear train is churning oil) • An internal air leak (air is mixing with the fluid). Have the transmission checked professionally.
Solid residue in the fluid	• Defective bands, clutch pack or bearings. Bits of band material or metal abrasives are clinging to the dipstick. Have the transmission checked professionally.
Varnish coating on the dipstick	• The transmission fluid is overheating

Fluid Pan and Filter

REMOVAL AND INSTALLATION

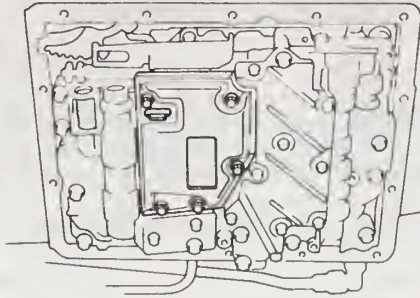
CAUTION

This procedure should always be done with the engine and transmission cold. Transmission oil becomes hot enough during operation to inflict serious burns or scalds.

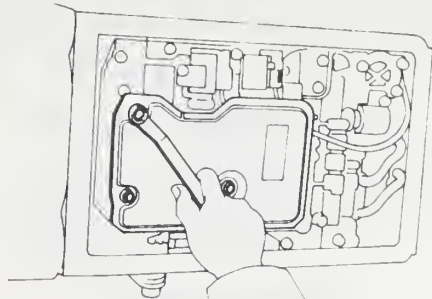
1. Jack up the front end of the vehicle and support it on jackstands.

2. Place a container under the transmission drain plug and drain the transmission fluid.

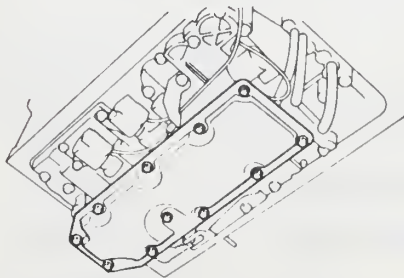
3. Remove the pan securing bolts and remove the pan and gasket. On all but the A43/A44 family, this will require the use of a thin, flat bladed tool to cut the sealant bead. Do NOT use a screwdriver (you'll deform the pan lip) and do NOT drive the tool straight into the seam; if it goes too far, internal damage will result. Work on an angle to the pan and tap the tool just deeply enough to cut the sealer.



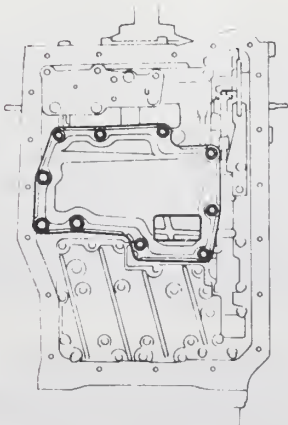
Oil strainer removal, A43D and A44D



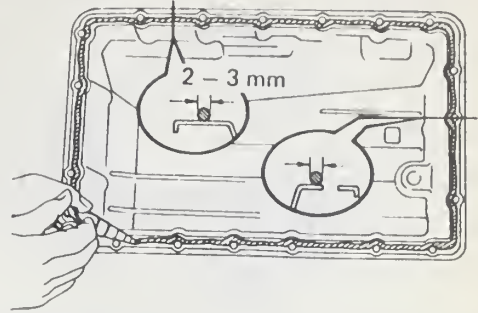
Three bolts hold the strainer on A340E transmissions



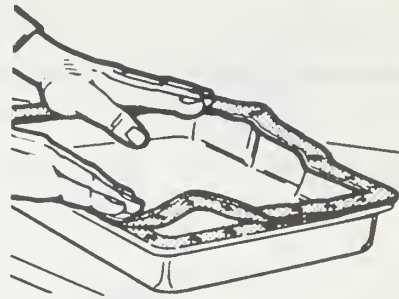
Oil strainer bolts, A340F and A340H



Don't lose the 7 washers when removing the A440F strainer



Sealant must be applied carefully onto a completely clean surface



The A43D and A44D pans always get a new gasket; it is applied dry, never with sealant

4. The pan may be washed in solvent for cleaning but must be absolutely dry when it is reinstalled. Do not wipe it out with a rag; the lint from the rag can damage the transmission. Additionally, the pans for the A43D, A44D and A440F units contain magnets; clean any shavings from the magnets and make certain the magnet(s) are correctly positioned before reinstallation.

5. Remove all traces of the old gasket or sealer from the pan and from the transmission. On A43/A44 series, install a new gasket on the pan but do not use any sealer. On all other units, apply a thin, even bead of sealant around the pan, staying in-board of the screw holes and roughly centered on the pan flange.

6. Inspect, clean or replace the transmission filter or strainer at this time, if necessary. If the filter is removed, be ready for an additional rush of fluid. For all transmissions except the A440F, tighten the bolts to 48 inch lbs. (5.5 Nm). On the A440F, tighten the 8mm bolts to 48 inch lbs. (5.5 Nm) and the 10mm bolts to 7 ft. lbs. (10 Nm).

7. Install the pan, tightening the securing bolts to the proper torque in a criss-crossing pattern. Correct pan bolt tightness:

- A43D and A44D: 48 inch lbs. (5.5 Nm).
- A340E, F and H: 65 inch lbs. (7.4 Nm)
- A440F: 61 inch lbs. (6.9 Nm).

WARNING: The pan bolts must be tightened evenly; the bolts break easily if overtightened.

8. Fill the transmission to the correct level with the specified fluid.

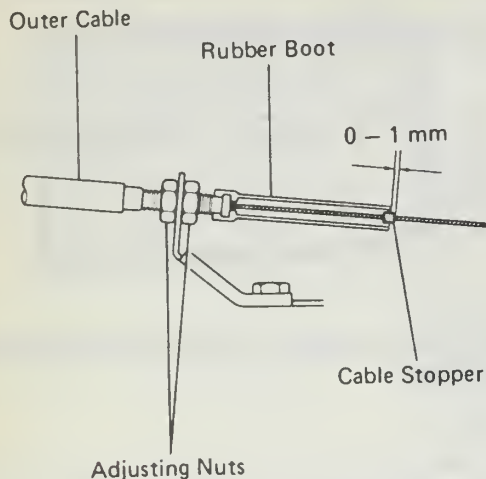
Adjustments

THROTTLE CABLE

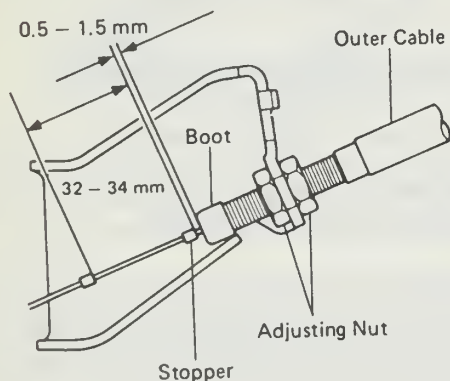
Truck and 4Runner

1. Remove the air cleaner assembly.
2. Push the accelerator to the floor and check that the throt-

7 DRIVE TRAIN



Throttle cable measurement, Truck and 4Runner



Measuring the Land Cruiser throttle cable

the plate opens fully. If not, adjust the accelerator linkage so that it does.

3. Push back the rubber boot from the throttle cable which runs down to the transmission. Loosen the throttle cable adjustment nuts so that the cable housing can be adjusted.

4. Fully open the carburetor throttle by having an assistant press the accelerator all the way to the floor.

5. Adjust the cable housing so that, with the throttle wide open, the distance between the end of the rubber boot and the cable stopper is 0-1mm.

6. Tighten the nuts and double check the adjustment. Install the rubber boot and the air cleaner.

Land Cruiser

1. Inspect the throttle cable and its mounts. Neither the cable nor the mounts should be deformed or bent.

2. With the throttle fully closed, measure the distance between the end of the boot and the stopper. Correct distance is 0.5-1.5 mm (0.020-0.059 inch).

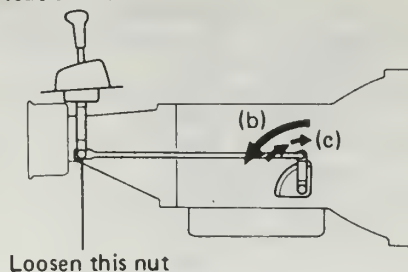
3. Have an assistant open the throttle fully. Remeasure the distance. Correct distance is 32-34 mm (1.26-1.34 inches).

4. If distances are not correct, adjust the cable via the adjusting nuts at the bracket.

SHIFTER POSITION/LINKAGE

1. Loosen or disconnect the nut holding the horizontal shift rod to the bottom of the shift selector.

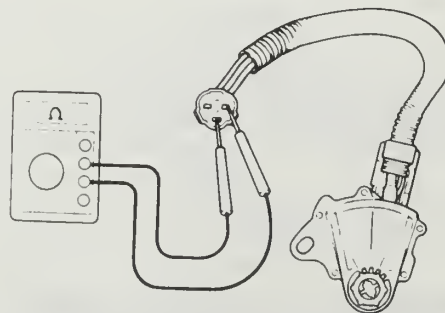
Neutral Position



Typical shifter adjustment. A44D shown, others similar



Transfer linkage adjustment point



Checking the transfer position switch

2. Move the now loosened or removed rod downward or towards the back of the vehicle. This will cause the shift lever (on the transmission case) to move into approximately the 9 o'clock or horizontal position.

3. On A43D, A44D and A340F transmissions, move the horizontal rod upwards or towards the front until the 3rd notch is engaged. This should put the transmission in N and bring the small arm at the transmission near the vertical position.

4. For A340F, A340H and A440 units, return or move the arm until the 2nd notch is engaged. This should put the transmission in N and bring the small arm at the transmission near the vertical position.

5. Set the shift selector inside the vehicle to the N position.

6. Have an assistant hold the shift selector lightly towards the R position. Reconnect and/or adjust the linkage to the lower part of the shift selector and tighten the bolts.

7. Start the engine and make sure that the vehicle moves forward when shifted into the D range and moves rearward when shifted into R.

TRANSFER LINKAGE

A340E and A340H

1. Shift the transfer lever to the **H2** position.
2. Disconnect the No. 1 transfer linkage from the cross shaft.
3. Position the transfer indicator switch to the **H2** position.
4. Connect the No. 1 transfer linkage to the cross shaft.

TRANSFER POSITION SWITCH

A340E and A340H

1. Loosen the transfer position switch bolt and set the shift position to the **L4** position.
2. Disconnect the electrical connector.
3. Connect an ohmmeter between the terminals and adjust the switch so there is continuity.
4. Connect the electrical lead and tighten the switch bolt to 48 inch lbs. (5.4 Nm).
5. Check the idle speed.

Neutral Safety Switch

The neutral safety switch prevents the vehicle from starting unless the gearshift selector is in either the **P** or **N** positions. If the vehicle will start in any other positions, adjustment or replacement of the switch is required.

ADJUSTMENT

1. Loosen the neutral start switch bolt.
2. Place the gearshift selector lever in the **N** position.
3. Align the shaft groove of the switch with the neutral Basic line. Hold the switch in this position and tighten the switch bolts to 35-60 inch lbs.
4. With the parking brake set and the brake pedal fully applied, attempt to start the engine in each shifter range. The engine should only start in **N** or **P**.

Extension Housing Seal

REMOVAL AND INSTALLATION

A43D, A44D and A340E

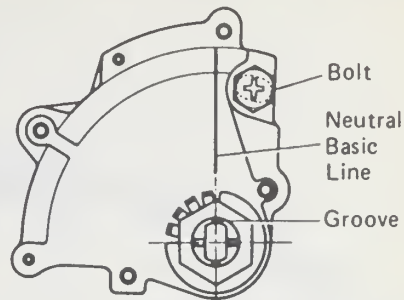
1. Elevate and safely support the vehicle.
2. Position a catch pan below the work area to contain spilled fluid.
3. Remove the driveshaft.
4. Clean the extension housing area thoroughly before removing the seal. No dirt must be allowed to enter the transmission during replacement.
5. Using a seal extractor such as tool 09308-10010 or equivalent, remove the seal.
6. Use a seal driver such as tool 09325-20010 or equivalent, drive the new seal into place as far as it will go.
7. Install the driveshaft.
8. Lower the vehicle and start the engine. With the brake applied, shift the transmission through each position, pausing long enough to allow the gear to fully engage. Place the selector in **P** and check the fluid level, topping the fluid as needed. Do NOT overfill the fluid.

Transmission

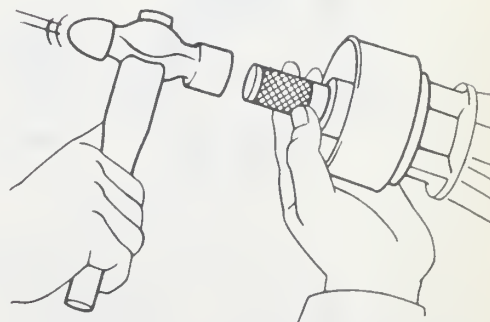
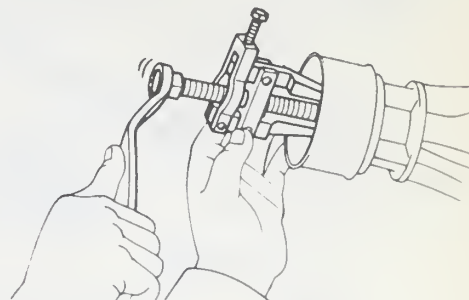
REMOVAL AND INSTALLATION

A43D, A44D and A340E

1. Disconnect the battery cables at the battery.



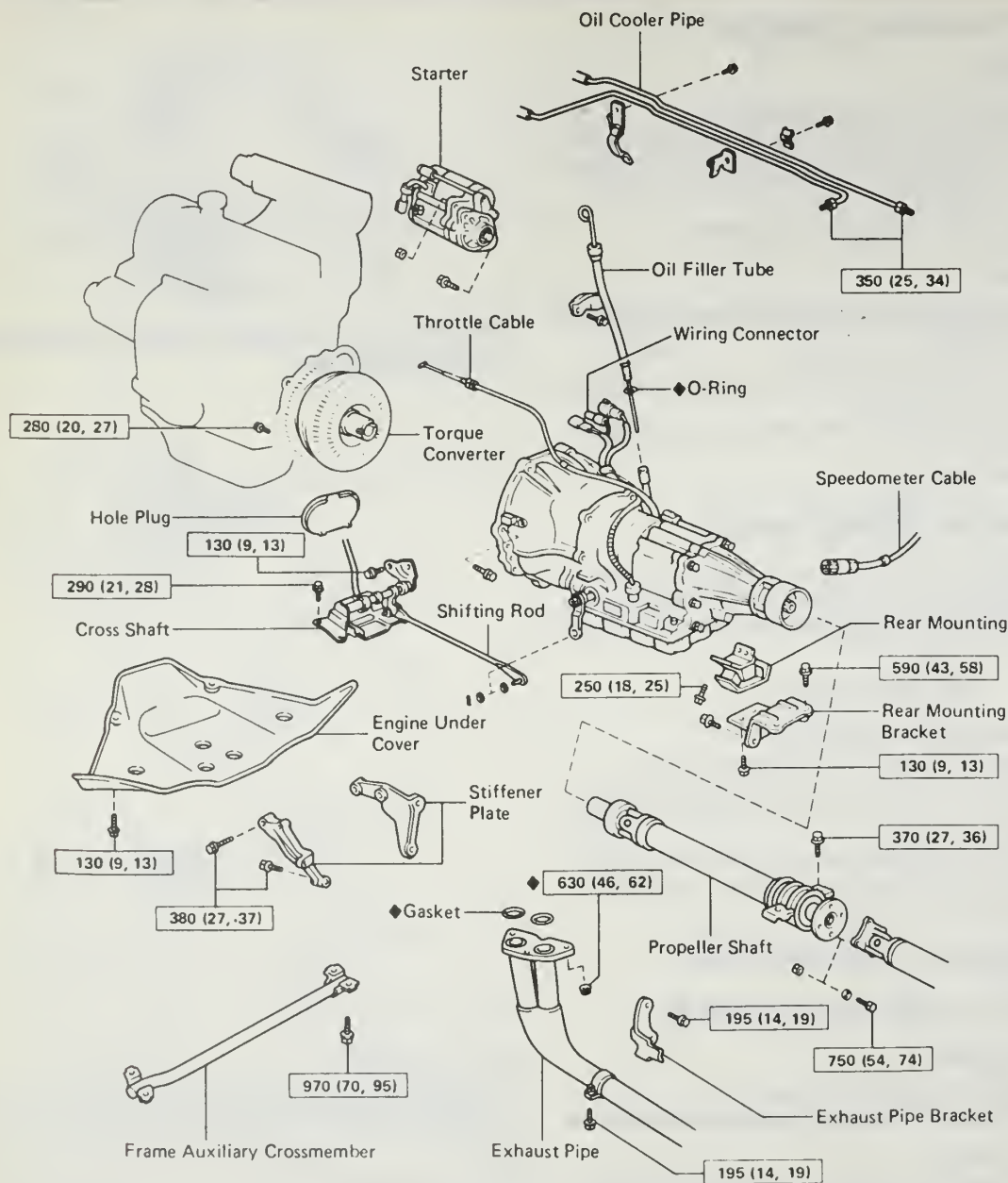
The neutral switch groove must be aligned with the Neutral Basic line



Removing and Installing the extension housing oil seal

2. Remove the air cleaner assembly.
3. Disconnect the transmission throttle cable.
4. Raise the vehicle and support it safely with jackstands. Double check the security and placement of the stands.
5. Disconnect the wiring connectors near the starter.
6. Disconnect the starter wiring at the starter. Unbolt the starter and remove it from the vehicle.
7. Drain the transmission fluid.
8. Chalk matchmarks on the rear driveshaft flange and the differential pinion flange. These marks must be aligned during installation.
9. Unbolt the rear driveshaft flange. If the vehicle has a two piece driveshaft, remove the center bearing bracket-to-frame bolts. Remove the driveshaft from the vehicle.
10. Disconnect the speedometer cable from the transmission and tie it out of the way.
11. Disconnect the shift linkage at the transmission.
12. Disconnect the exhaust pipe clamp at the bell housing and remove the transmission dipstick and oil filler tube.

7 DRIVE TRAIN



A43D transmission external components

13. Disconnect the transmission oil cooler lines at the transmission.

14. Support the transmission using a jack with a wooden block placed between the jack and the transmission pan. Do not raise the transmission, just raise the jack until the wooden block touches the transmission pan.

15. Place a wooden block (or blocks) between the engine oil pan and the front frame crossmember.

NOTE: The wooden block(s) should be no more than about 6mm away from the engine so that when the engine is lowered, damage will not occur to any underhood components.

16. Remove the transmission mount-to-crossmember bolts.

17. Raise the transmission SLIGHTLY, just enough to take the weight of the transmission off of the crossmember. Remove the crossmember-to-frame mounting bolts and remove the crossmember from the vehicle. For vehicles with the A43D, remove the bracket and rear transmission mount.

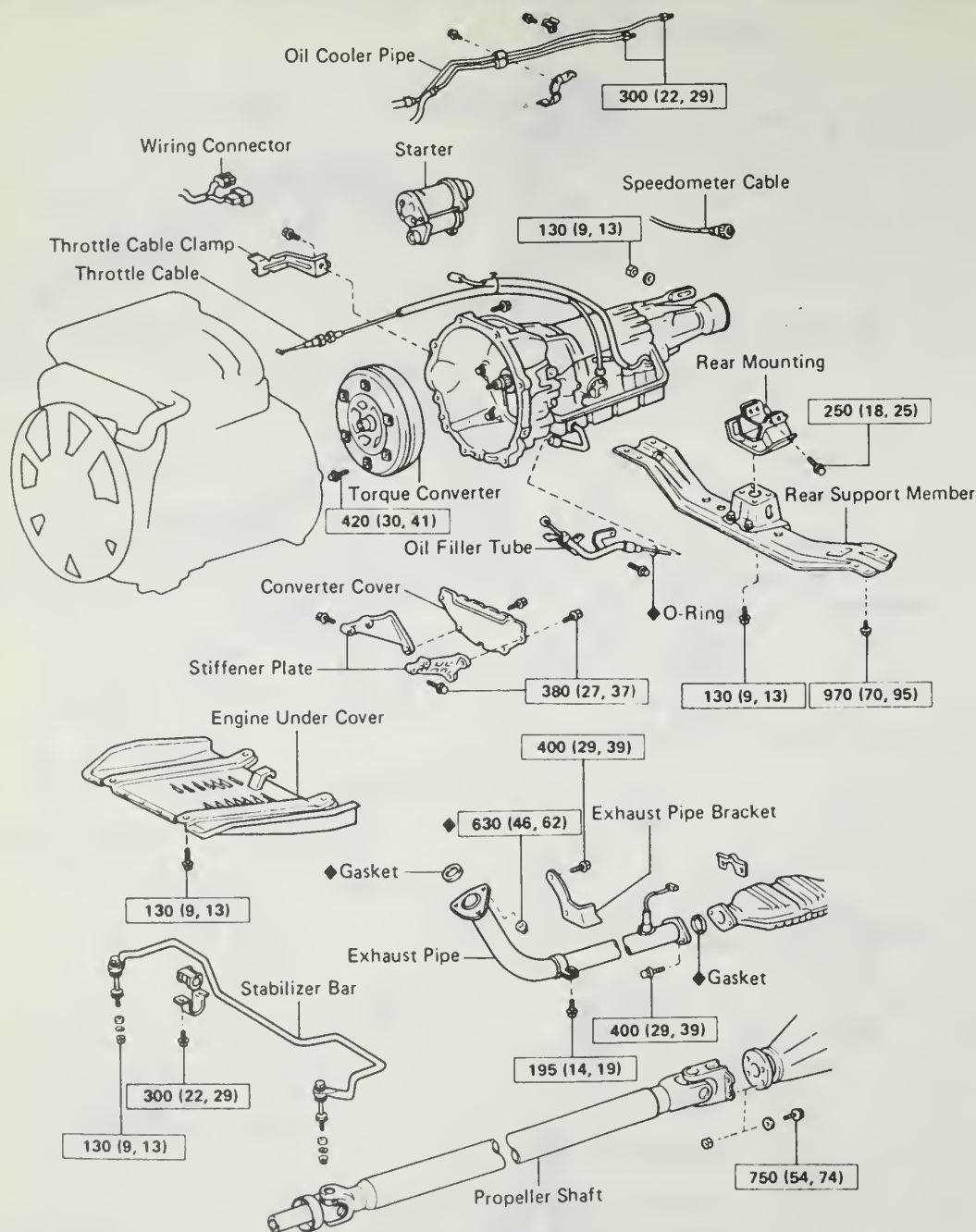
18. Slowly lower the transmission until the engine rests on the wooden block placed during Step 15.

19. Remove the engine undercover in order to gain access to the engine crankshaft pulley.

20. Remove the rubber plugs from the service holes located at the rear of the engine in order to gain access to the torque converter bolts.

21. Rotate the crankshaft as necessary to remove the torque converter retaining bolts. Access to these bolts is through the service holes mentioned in Step 20.

7 DRIVE TRAIN



A340D transmission external components

22. Obtain a bolt of the same dimensions as the torque converter bolts. Cut the head off of the bolt and hacksaw a screwdriver slot in the bolt opposite the threaded end.

NOTE: This modified bolt is used as a guide pin. Two guide pins are needed to properly install the transmission.

23. Thread the guide pin into one of the torque converter bolt holes. The guide pin will help keep the converter with the transmission.

24. Remove the transmission-to-engine mounting bolts.

25. Carefully move the transmission rearward by prying on the guide pin through the service hole.

NOTE: As soon as the transmission is away from the engine about 3mm, feed wire through the front of the transmission and secure the wire in order to keep the converter attached to the transmission. Also, try to keep the nose of the transmission pointed upward **SLIGHTLY** to help keep the converter in place.

26. Pull the transmission rearward and lower it out of the vehicle.

NOTE: Do not allow the attached cables to catch on any components during removal.

27. With the transmission out of the vehicle, remove the torque converter as follows:

- a. Place a drain pan under the front of the transmission
- b. Pull the converter straight off the transmission and allow the fluid to drain.

NOTE: Prior to installation of the transmission, Toyota recommends checking the torque converter and flywheel runout dimensions. If either of these runout limits are beyond the maximum allowable limits, excessive wear of the front transmission seal will occur.

28. Mount the torque converter on the flywheel and torque the converter bolts to 20 ft. lbs. (27 Nm) for A43D and A44D transmissions. For A340E, tighten them to 30 ft. lbs. (41 Nm).

29. Mount the dial indicator so that the indicator probe touches the outer surface of the converter extension sleeve (90° to the converter centerline).

30. Adjust the dial indicator to zero.

31. Slowly rotate the converter and read the dial indicator. The indicator needle should not deviate more than 0.30mm.

32. Remove the torque converter from the flywheel.

33. Mount the dial indicator so that the indicator probe touches the flywheel ring gear just inside of the gear teeth (surface faces the rear of the vehicle).

34. Zero the indicator needle and slowly rotate the flywheel. The indicator needle should not deviate more than 0.20mm.

To install:

35. Apply a coat of multi-purpose grease to the torque converter stub shaft and the corresponding pilot hole in the flywheel.

36. Install the torque converter into the front of the transmission. Push inward on the torque converter while rotating it to completely couple the torque converter to the transmission.

37. To make sure that the converter is properly installed, measure the distance between the torque converter mounting lugs and the front mounting face of the transmission. The proper distance is 20.0 mm for A43D and A44D; for A340E, correct distance is 18.0mm.

38. Install the guide pins into two opposite mounting lugs of the torque converter.

39. Raise the transmission to the engine and align the transmission with the engine alignment dowels. Also, position the converter guide pins into the mounting holes of the flywheel.

40. Install and tighten the transmission-to-engine mounting bolts. Torque the bolts to 47 ft. lbs. (64 Nm).

41. Remove the converter guide pins and install the converter mounting bolts. Rotate the crankshaft as necessary to gain access to the guide pins and bolts through the service holes.

42. Evenly tighten the converter mounting bolts to 20 ft. lbs. (27 Nm) for A43D and A44D transmissions. For A340E, tighten them to 30 ft. lbs. (41 Nm). lbs. Install the rubber plugs into the access holes.

43. Install the engine undercover.

44. Raise the transmission slightly and remove the wood block(s) from beneath the engine oil pan.

45. Install the transmission crossmember. Torque the cross-

member-to-frame bolts to 70 ft. lbs. (95 Nm). For A43D, install the rear mounting bracket and tighten the bolts to 43 ft. lbs. (58 Nm).

46. Lower the transmission onto the crossmember and install the transmission mounting bolts. Torque the bolts to 18 ft. lbs. (25 Nm).

47. Install the oil filler tube and connect the exhaust pipe clamp.

48. Connect the oil cooler lines to the transmission and torque the fittings to 23 ft. lbs. (31 Nm).

49. Connect the shift linkage and the speedometer cable.

50. Install the driveshaft and the starter.

51. Connect the wiring harnesses.

52. Connect and adjust the transmission throttle cable.

53. Install the air cleaner assembly and connect the battery cables.

54. Fill the transmission with the correct fluid. If the torque converter was completely drained, the transmission will need about 7 quarts of fluid.

55. Road test the vehicle and check for leaks.

A340F and A340H

1. Disconnect the negative battery cable.

2. Disconnect the air intake connector.

3. Loosen the adjusting nuts and disconnect the throttle cable housing at the bracket. Disconnect the cable at the linkage and then disconnect it from the rear of the engine.

4. Underneath the air intake chamber there are 5 connectors; disconnect them.

5. Remove the upper starter mounting bolt.

6. Raise the vehicle, support it on safety stands and drain the transmission fluid.

7. Remove the driveshafts.

8. Remove the 2 bolts, bracket and pipe clamp and then disconnect the exhaust pipe at the tail pipe.

9. Disconnect and plug the 2 oil cooler lines at the transmission case.

10. Pull out the cotter pin and disconnect the manual shift linkage at the neutral safety switch.

11. Pull the cotter pins and disconnect the No. 1 and No. 2 transfer shift linkages at the cross shaft over the transmission case. Remove the cross shaft.

12. Disconnect the speedometer cable.

13. Disconnect the 2 oil cooler lines at the transfer case.

14. Using a transmission jack, or a floor jack and a block of wood, raise the transmission just enough to remove pressure from the rear support member.

15. Position a piece of wood between the firewall and the rear of the cylinder head, remove the 8 bolts and lift out the rear support member.

16. Remove the engine under cover.

17. Remove the 6 torque converter mounting bolts.

NOTE: Rotate the crankshaft in order to gain access to the torque converter mounting bolts.

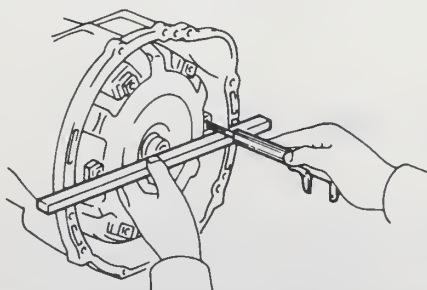
18. Insert a guide pin (just cut off the head of an old bolt) into one of the torque converter bolt holes.

19. Remove the starter and then remove the transmission housing mounting bolts.

20. Using the guide pin to keep the transmission and torque converter together, pry on the end of the pin to get the transmission assembly moving rearward. Be careful!

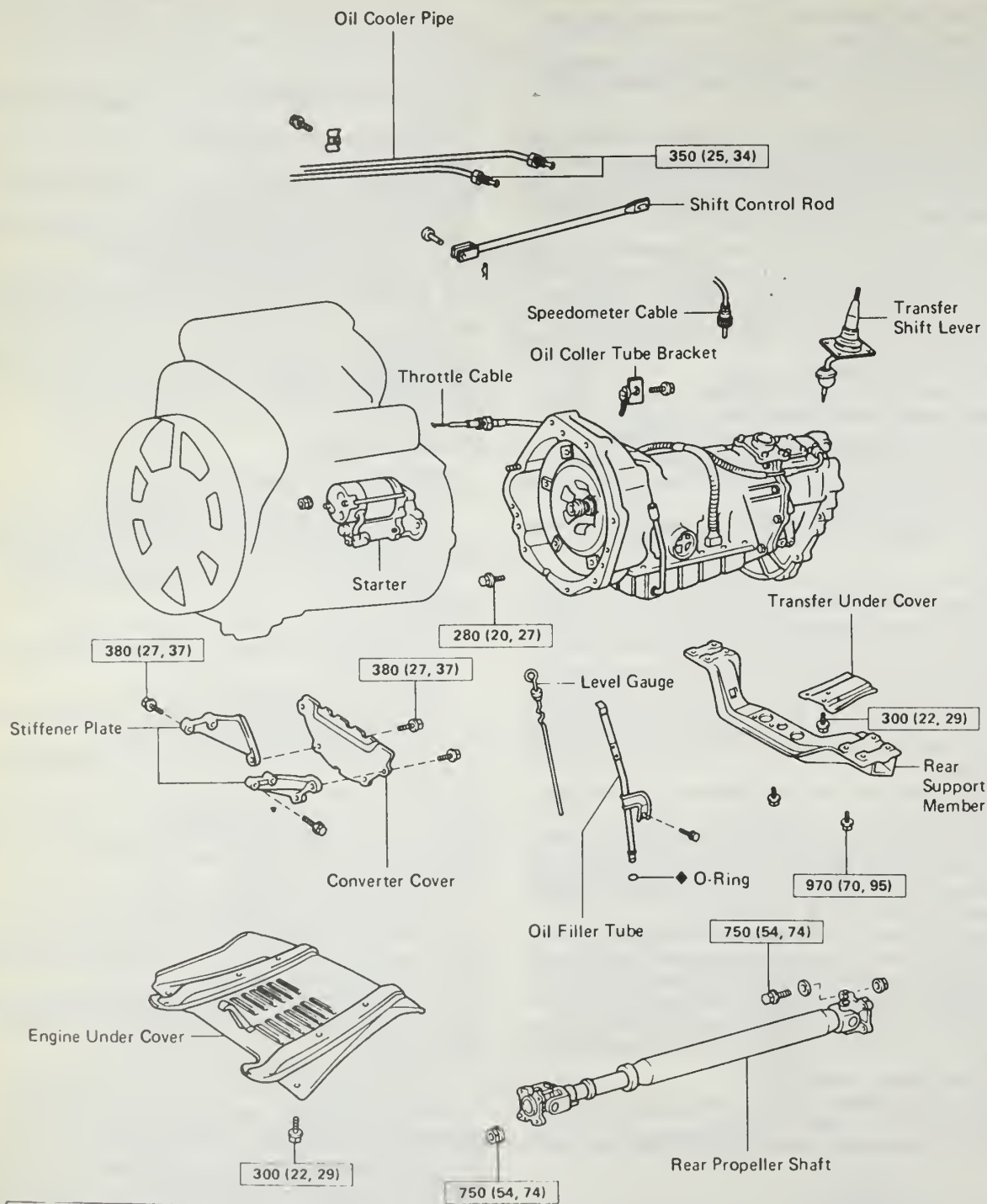
21. With a large drip pan under the assembly, pull off the converter. Remove the filler tube from the side of the transmission case.

NOTE: Prior to installation of the transmission, Toyota recommends checking the torque converter and flywheel runout dimensions. If either of these runout limits are beyond the maximum allowable limits, excessive wear of the front transmission seal will occur.



Torque converter clearance must be checked before installation

7 DRIVE TRAIN



kg-cm (ft-lb, N-m) : Specified torque

◆ Non-reusable part

External transmission components — A340F

22. Mount the torque converter on the flywheel and torque the converter bolts to 30 ft. lbs.

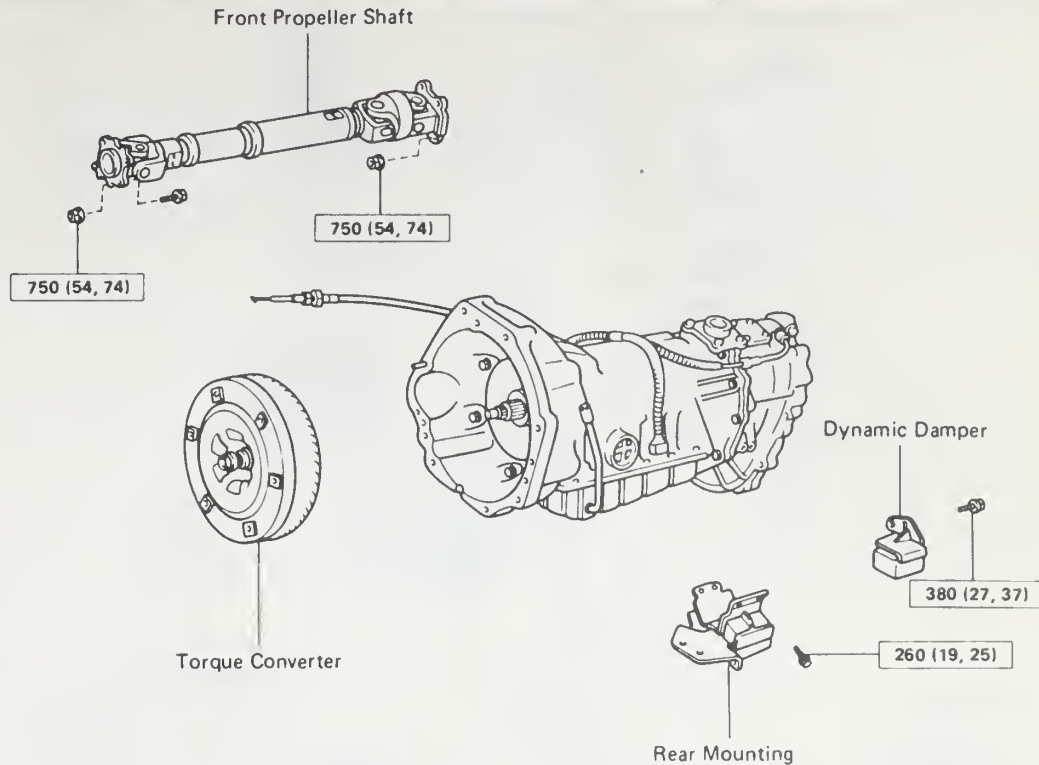
23. Mount the dial indicator so that the indicator probe touches the outer surface of the converter extension sleeve (90° to the converter centerline).

24. Adjust the dial indicator to zero.

25. Slowly rotate the converter and read the dial indicator. The indicator needle should not deviate more than 0.30mm.

26. Remove the torque converter from the flywheel.

27. Mount the dial indicator so that the indicator probe touches the flywheel ring gear just inside of the gear teeth (surface faces the rear of the vehicle).



External transmission components — A340F

28. Zero the indicator needle and slowly rotate the flywheel. The indicator needle should not deviate more than 0.20mm.

To Install:

29. Use a new O-ring and press the filler tube into the transmission case.

30. Coat the pilot hole in the crankshaft and the center hub of the converter with grease.

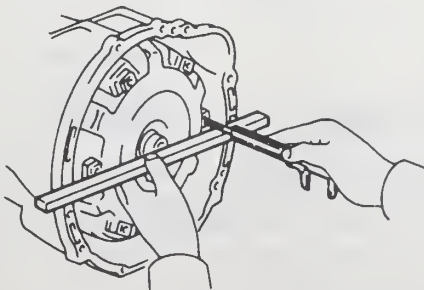
31. Install the torque converter into the transmission case. Using calipers and a straight edge, make sure the distance from the installed surface of the converter to the transmission housing lip is 26mm.

32. Install a guide pin in the converter and align it with one of the drive plate holes. Align the 2 sleeves on the cylinder block with the converter housing and temporarily install a bolt.

CAUTION

Never tilt the transmission forward during installation; the converter will fall out.

33. If all holes are aligned, install the starter and then all remaining transmission housing bolts. Tighten to 47 ft. lbs. (64 Nm).



Torque converter clearance must be checked before installation

34. Remove the guide pin and install the 6 converter bolts. Tighten the bolts evenly to 20 ft. lbs. (27 Nm) on models with 4 cylinder engines and to 30 ft. lbs. (41 Nm) on those with the V6.

35. Install the engine under cover.

36. Install the rear support member and tighten the 8 bolts to 70 ft. lbs. (95 Nm).

37. Connect the transfer case oil cooler lines.

38. Connect the speedometer cable being sure that the washer and felt dust protector are still on the end.

39. Connect the shift linkage using a new cotter pin.

40. Coat the cross shaft joint with grease and then install the shaft to the body. Connect the 2 transfer linkages to the cross shaft.

41. Connect the oil cooler lines to the transmission case and install the bracket.

42. Connect the exhaust pipe to the tailpipe. Tighten the connecting nuts and pipe clamp bolt to 32 ft. lbs. (43 Nm).

43. Install the front and rear driveshafts.

44. Connect the five connectors under the air intake chamber.

45. Install the upper starter mounting nut.

46. Connect and adjust the throttle cable.

47. Connect the air intake connector and the negative battery cable. Fill the transmission with fluid and road test the truck. Check for any leaks.

A440F

1. Disconnect the negative battery cable.

2. Remove the battery and the battery cover.

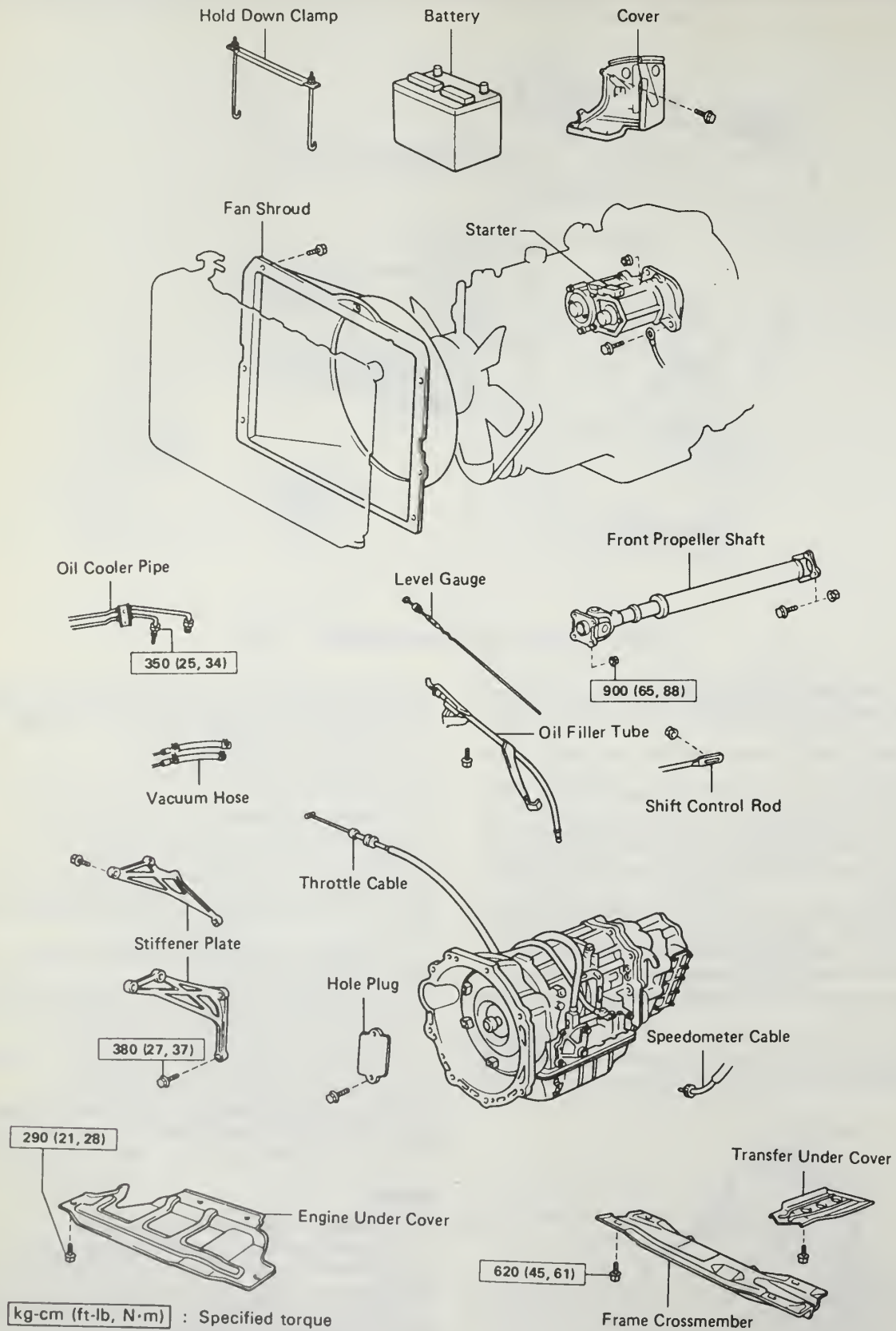
3. Loosen the cooling fan shroud bolts. This will avoid fan damage.

4. Loosen the adjusting nuts for the throttle control cable. Disconnect the cable housing from the bracket; disconnect the cable from the throttle linkage.

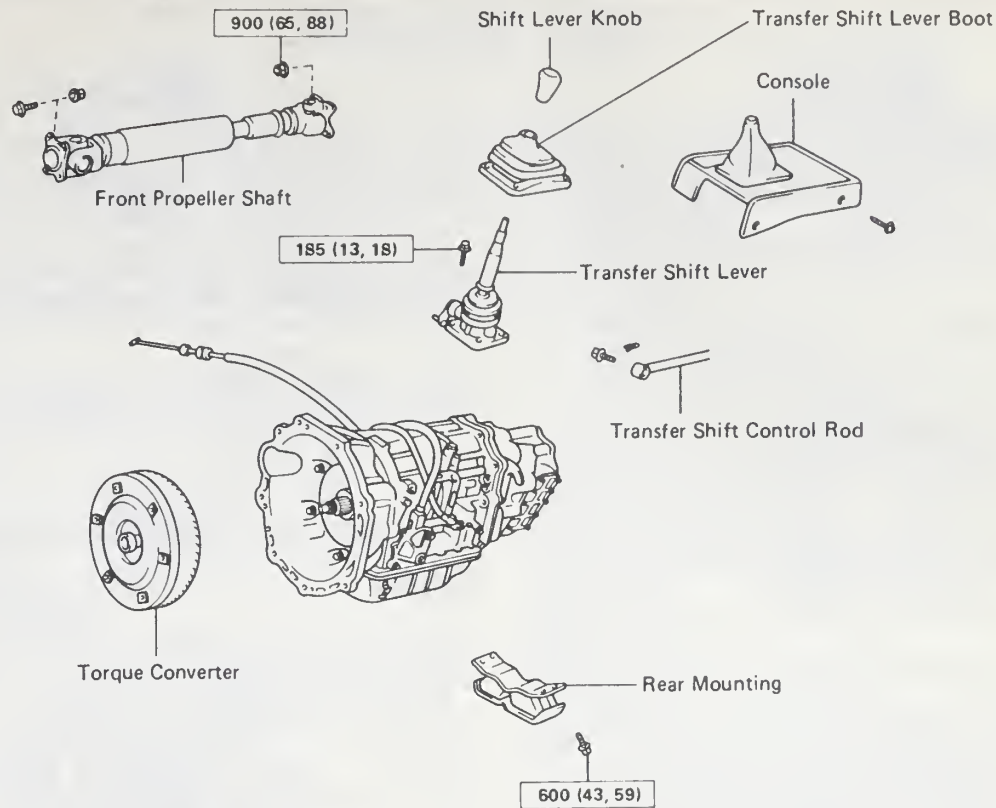
5. Disconnect the electrical connectors near the starter.

6. Remove the transfer shift lever as follows:

7 DRIVE TRAIN



A440F transmission external components



A440F transmission external components (continued)

- a. Under the vehicle, remove the nut and transmission control rod.
- b. Remove the transfer shift lever knob.
- c. Remove the four screws holding the console and remove the console.
- d. Remove the four bolts and remove the transfer shift lever boot.
- e. Remove the three bolts holding the console box.
- f. Remove the six bolts holding the transmission shift lever assembly. Remove the assembly.
- g. Pull out the pin and disconnect the shift rod.
- h. Remove the four bolts holding the transfer shift lever and remove the lever assembly.
7. Elevate and safely support the vehicle. Double check the supports for placement and security.
8. Disconnect the speedometer cable.
9. Remove the front and rear propeller shafts.
10. Remove the starter.
11. Remove the two line clamps and disconnect the oil cooler lines at the transmission.
12. Remove the undercover.
13. Remove the endplate hole plug. Turn the crankshaft to gain access to each of the six torque converter mounting bolts. Remove the bolts.
14. Support the transmission, either with a transmission jack (preferred) or a floor jack and a broad piece of wood to protect the transmission. Tension the jack just enough to take tension off the crossmember.
15. Remove the bolts and nuts holding the crossmember and remove it.
16. Use a floor jack and a piece of wood to support the engine under the oil pan. Do NOT bend the oil pan.

17. Lower the rear end of the transmission and slide the unit away from the engine.

18. With the transmission removed, set up a dial indicator and measure the driveplate runout. If runout exceeds 0.20 mm (0.0079 in.) or if the ring gear is damaged, the drive plate must be replaced.

19. Temporarily mount the torque converter to the drive plate. Set up a dial indicator and measure runout at the center of the torque converter. If runout exceeds 0.30 mm (0.0118 in.), try to correct it by repositioning the torque converter. If the repositioning corrects the error, make matchmarks so that the position is used at reinstallation. If the misalignment cannot be corrected, the torque converter must be replaced. Remove the torque converter when measurement is completed.

To install:

20. With the torque converter installed on the transmission, check the converter installation with a straight edge across the front of the case. Correct distance from the surface of the bolt lugs to the front of the case is 15.7mm (0.618 in.) or more. If the distance measured is less than specified, check the converter for improper installation.

21. Elevate the transmission and push it fully into place. Install the transmission retaining bolts and tighten them to 53 ft. lbs. (72 Nm).

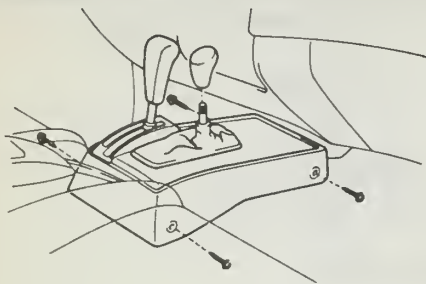
22. Install the rear mount to the transmission. Tighten the retaining bolts to 43 ft. lbs. (59 Nm).

23. Install the crossmember. Tighten the bolts to 45 ft. lbs. (61 Nm) and the nuts to 43 ft. lbs. (59 Nm).

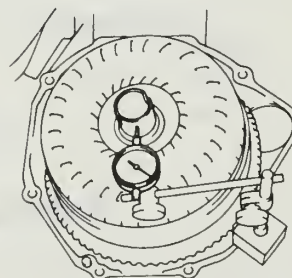
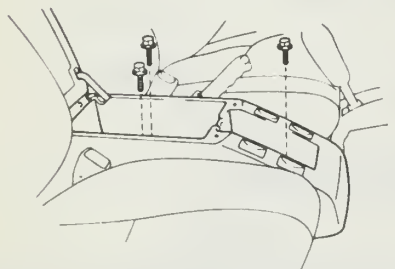
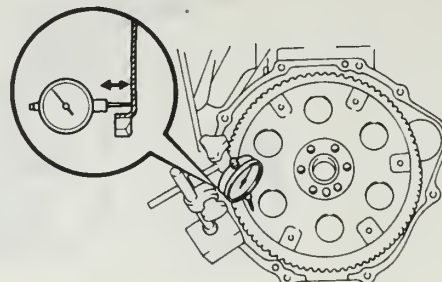
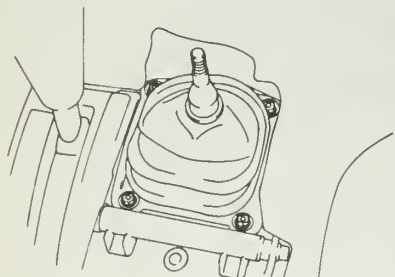
24. Install the torque converter mounting bolts, tightening them to 21 ft. lbs. (28 Nm). Install the end plate hole plug when finished.

25. Install the undercover.

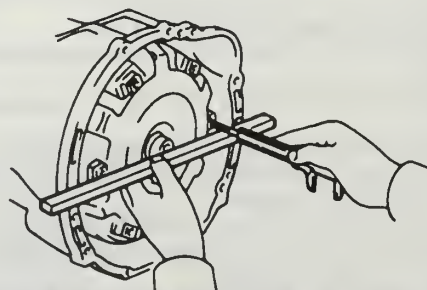
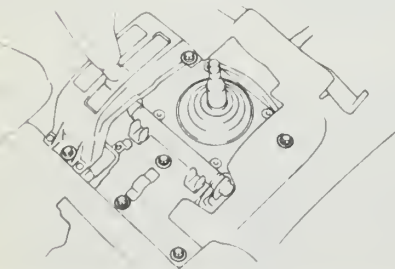
7 DRIVE TRAIN



The transfer shift lever is held by 4 bolts

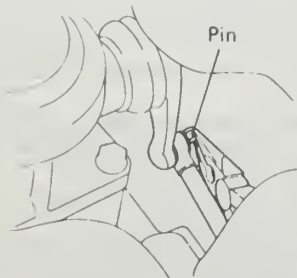


Measuring runout of the drive plate and torque converter



Torque converter clearance must be checked before installation

26. Connect the oil cooler lines, tightening the fittings to 25 ft. lbs. (34 Nm). Install the cooler line clamps.
27. Install the front and rear driveshafts.
28. Install the oil filler tube.
29. Install the starter.
30. Connect the speedometer cable.
31. The transfer shift lever is installed by reversing the removal sequence (refer to Step 6). The four transfer shift lever bolts should be tightened to 13 ft. lbs. (18 Nm). The six bolts holding the transmission shift lever should be tightened only to 48 inch lbs. (5.4 Nm).
32. Connect the electrical connectors near the starter.
33. Connect and adjust the throttle cable.
34. Tighten the fan shroud bolts.
35. Connect the negative battery cable.
36. Add the correct amount of fluid.



Steps in removing the transfer shift lever

TRANSFER CASE

Applications

Toyota Trucks and 4Runners use either the RF1A or VF1A transfer. The RF1A uses a counter-gear reduction scheme and is found in vehicles with the 22R-E with W56 transmission. Gear ratio in H2 and H4 is 1.000 and in L4 is 2.276.

The VF1A transfer is a planetary gear reduction unit. It is found in vehicles with the 22R-E coupled with either the G58 or A340F transmissions as well as vehicles with the 3VZ-E engine and the R150F transmission. Its gear ratio is 1.000 in H2 and H4 and 2.566 in L4.

The Land Cruiser employs the HF2A transfer, used with the A440F transmission for full time 4WD application. In the high speed range, the gear ratio is 1.00; in low speed range, the ratio is 2.488.

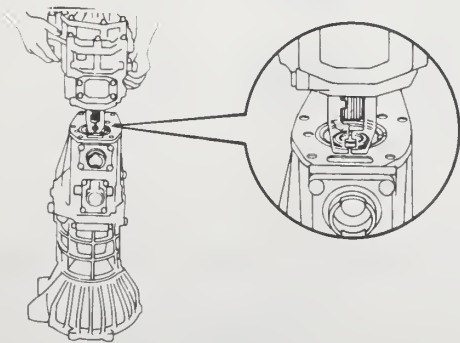
REMOVAL AND INSTALLATION

NOTE: The transfer case is removed as an assembly with the transmission.

1. Remove the transmission assembly. On 22R-E with G58 or A340F transmissions, remove the breather hose between the transmission control retainer and the transfer upper cover.
2. Remove the rear engine mount from the case. Remove the dynamic damper if one is present.
3. Remove the upper driveshaft dust cover.
4. Remove the transfer adapter rear mounting bolts and then pull the transfer case straight up and remove it.

NOTE: Be careful not to damage the adapter rear oil seal during removal.

5. Move the 2 shift forks into the **HIGH-FOUR** position.
6. Coat the adapter oil seal with grease and position a new gasket on the transfer case adapter.
7. Install the transfer case to the transmission. Tighten the bolts to 29 ft. lbs. (39 Nm). The longer bolts (43mm) are used at the dust cover, the shorter ones (39mm) are used in all other locations.
8. Install the rear engine mount and tighten the bolts to 19 ft. lbs. (25 Nm). Install the dynamic damper if one was removed.
9. Install the breather hose if one was removed. Install the transmission assembly.



Installing the transfer onto the transmission

OVERHAUL

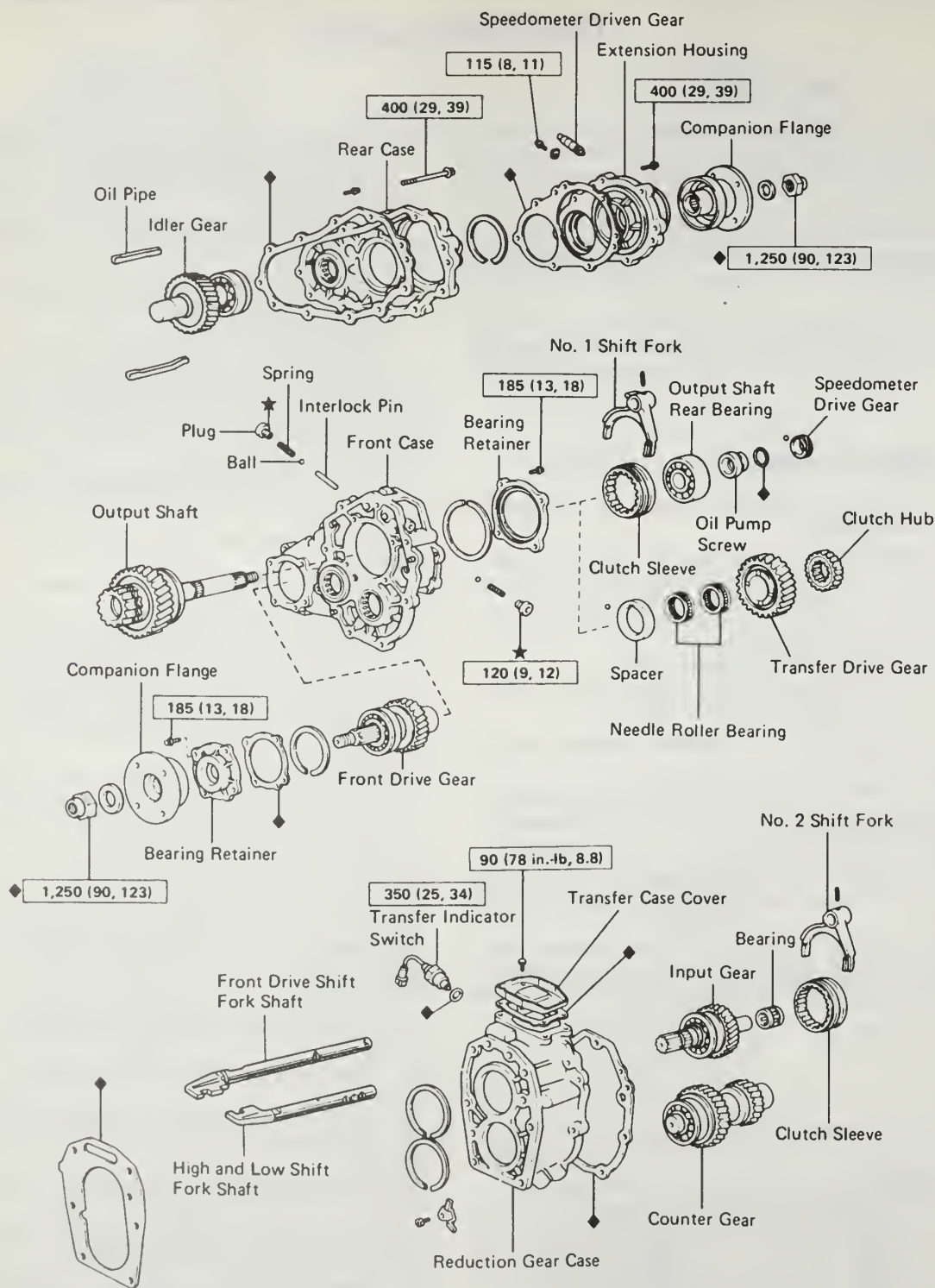
RF1A

1. Remove the front and rear companion flanges.
 2. Remove the extension housing.
 3. Remove the speedometer drive gear, steel ball, oil pump screw and bearing.
 4. Remove the rear case half with the idler gear in position, while holding the front half so that the clutch hub and steel ball do not fall out.
 5. Remove the idler gear from the rear case.
 6. Remove the front bearing retainer and front drive gear.
 7. Remove the 2 oil pipes.
 8. Remove the No. 1 shift fork and clutch sleeve.
 9. Remove the clutch hub and transfer drive gear. Remove the needle roller bearing, No. 2 spacer and steel ball. Remove the transfer case cover and shift lever retainer.
 10. Remove the screw cover plugs, springs and locking balls from both sides of the case.
 11. Remove the spring pins that retain the shift forks and remove the front shift fork shaft. Remove the interlocking pin and high/low fork.
 12. Remove the front case, tapping lightly with a plastic mallet.
 13. Remove the No. 2 shift fork, clutch sleeve and needle roller bearing from the input shaft.
 14. Remove the input gear and countergear from the reduction gear case. Remove the output shaft from the front case.
 15. Check the oil seal and thrust clearance of the transfer low gear. The clearance between the gear and shaft, with the needle bearing installed, should be 0.010-0.056mm. The thrust clearance with the spacer and bearing installed should be 0.010-0.25mm.
 16. Check the thrust drive gear clearance. Clearance between the gear and shaft with the needle bearing installed should be 0.010-0.050mm. Thrust clearance with the clutch hub and spacer installed should be 0.089-0.270mm.
 17. Measure the clearance between the shift forks and clutch sleeves. Clearance should be 1mm max.
 18. Inspect all parts. Replace and worn or damaged parts. If the bearings are to be replaced, you'll need an arbor press to remove and install them. When installing bearings, use the thickest possible snapping to insure minimum endplay.
- To assemble**
19. Place the output shaft in the front case.
 20. Install the front bearing retainer and torque the bolts to 10 ft. lbs.
 21. Install the input gear and countergear in the reduction case.
 22. Install the roller bearing on the input shaft.
 23. Install the No. 2 hub sleeve and No. 2 shift fork on the input shaft.
 24. Install the reduction gear case and new gaskets on the front case. Torque the bolts to 30 ft. lbs.

NOTE: Two different length bolts are used. May sure you get them in the correct holes.

25. Install the front drive gear, bearing retainer and new gasket. Torque the bolts to 14 ft. lbs.
26. Install the high/low shift fork, the interlock pin and front drive shift fork shaft.
27. Install the slotted spring pins. Install the balls, springs and side plugs. Tighten the plugs to 10 ft. lbs.
28. Install the locking ball and No. 2 spacer. Install the needle roller bearing, transfer low gear and clutch hub.
29. Install the No. 1 shift fork and hub sleeve.
30. Install the oil pipes.
31. Install the idler gear in the rear case.

7 DRIVE TRAIN

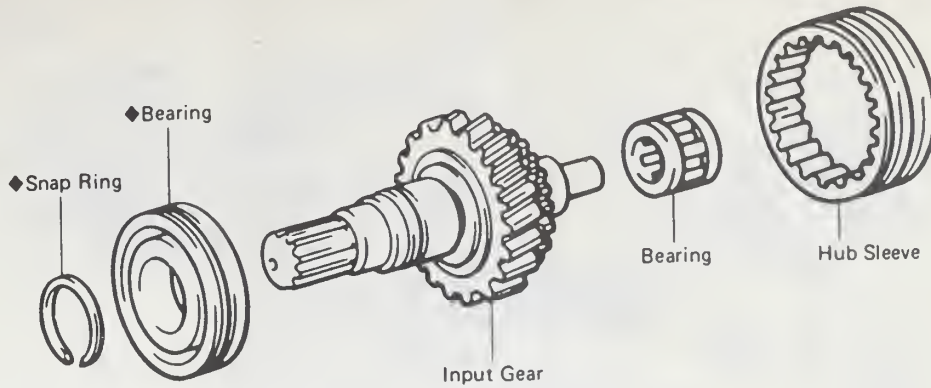


kg-cm (ft-lb, N-m) : Specified torque

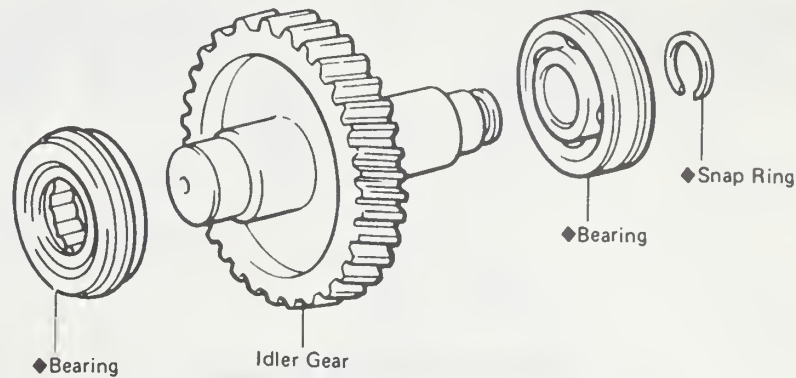
◆ Non-reusable part

★ Precoated part

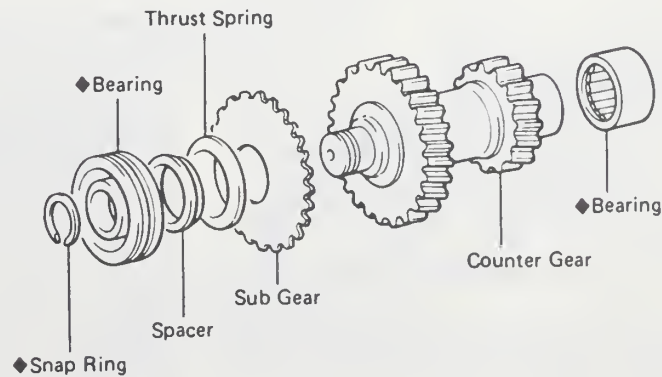
RF1A (counter gear) transfer components



RF1A input gear components



RF1A idler gear components



◆ Non-reusable part

RF1A counter gear components

32. Using anew gasket, install the rear case. Torque the bolts to 30 ft. lbs.

NOTE: Two different length bolts are used. Make sure you get them in the correct holes.

33. Install the bearing, oil pump screw, locking ball and speedometer drive gear.

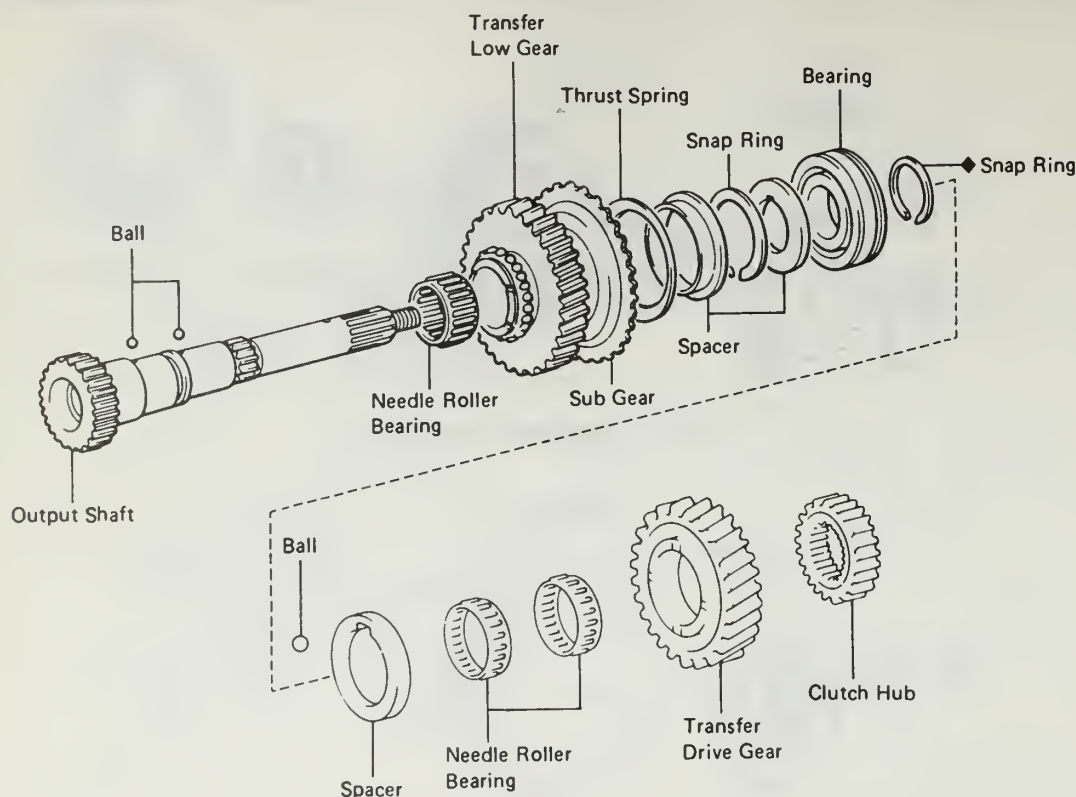
34. Install the extension housing with a new gasket. Torque the bolts to 30 ft. lbs.

35. Install the transfer case cover and shift lever retainer.

36. Install the front and rear flanges. Torque the fasteners to 90 ft. lbs.

37. Install the indicator switch and speedometer driven gear.

7 DRIVE TRAIN



RF1A output shaft components

VF1A

1. Remove the speedometer driven gear.
2. Remove the transfer indicator switch.
3. For 22R-E/A340F, remove the transfer L4 position switch.
4. For 22R-E/A340F or G58, use a pin punch and hammer to remove the slotted spring pins. Remove shift gear heads 1 and 2.
5. Remove the front retainer plate.
6. For 3VZ-E/R150F, remove the four bolts holding the shifter retainer, remove the retainer and remove the selector return spring from the retainer.
7. On 22R-E/A340F or G58, remove the upper cover and oil deflector.
8. Use a hammer and chisel to loosen the staked part of the nut on the front companion flange. Use a counterhold tool to hold the flange while the nut is loosened; use a puller to extract the flange.
9. Repeat the procedure to remove the rear companion flange.
10. Remove the extension housing. If necessary, tap the housing with a plastic mallet to loosen it after the bolts are removed.
11. Remove the speedometer drive gear. Remove the ball from the rear output shaft with a magnetic finger.
12. Remove the 12 bolts; separate the front and rear case.
13. Use a Torx® driver to remove the two screw plugs, the springs and the locking balls.
14. Remove the front drive fork shaft, fork and spring. Once the pin is driven clear of the shaft, hold the shaft in place when removing the punch. If not, the spring will launch the shaft across the workbench. Use a magnetic finger to remove the straight pin.
15. Remove the High and Low fork shaft, the fork and stopper.
16. Remove the snapping at the rear output shaft. Mount the

rear case in a vise with protected jaws; tap the case with a plastic mallet while holding the rear output shaft and driven sprocket.

17. For R150F and G58 transmissions, remove the synchronizer ring from the input shaft.

18. Remove the separator with the oil strainer. Remove the O-ring from the oil strainer pipe.

19. Remove the oil pump assembly.

20. Remove the oil pump drive gear.

21. Remove the snapping holding the planetary gear assembly. Pull the assembly out with the input shaft.

22. Use a flat tool to remove the snapping in the planetary gear assembly. Remove the low gear spline piece.

23. Remove the needle roller bearing from the input shaft.

24. Remove the input shaft stopper and thrust bearing. Don't lose the two small pins.

25. Remove the input shaft, thrust bearing and bearing race.

26. Remove the planetary ring gear. Start by removing the snapping, then remove the plug, retaining pin and spring. Lift the gear out.

27. Before reassembly, inspect each of the electrical switches removed. They are on/off switches which should have continuity across the terminals when the tip of the switch is pressed in; with the tip in the free position there should be no continuity.

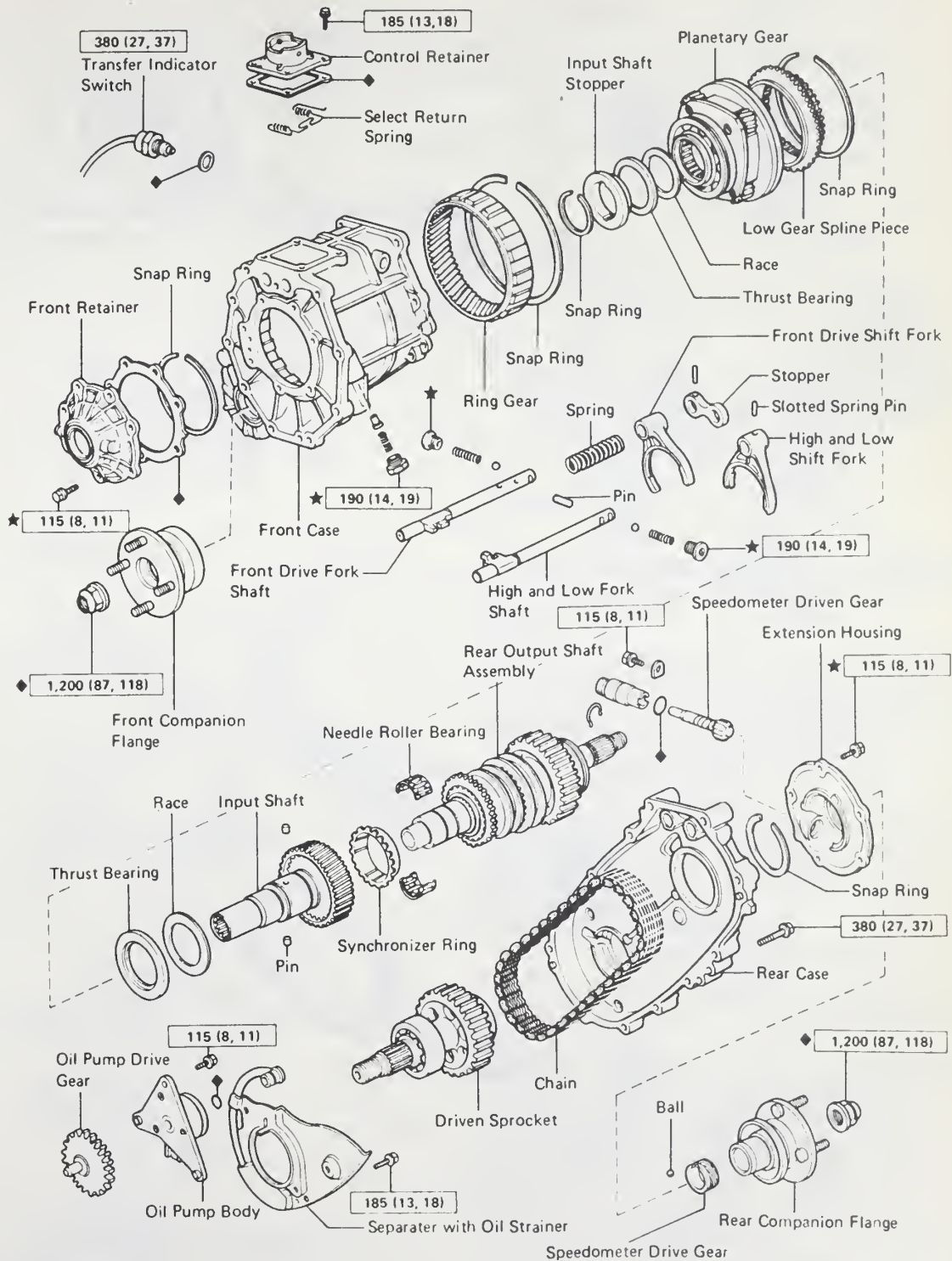
To install:

28. Install the planetary ring gear into the front case, making sure the gear is correctly positioned. Install the pin and spring. Apply liquid sealer to the plug; install the plug and tighten to 14 ft. lbs. (19 Nm).

29. Install the snapping holding the ring gear. Make certain the end gap of the snapping is NOT aligned with the upper side of the case.

30. Apply gear oil to the thrust bearing and race. Install the

[3VZ-E/R150F]



kg·cm (ft·lb, N·m) : Specified torque

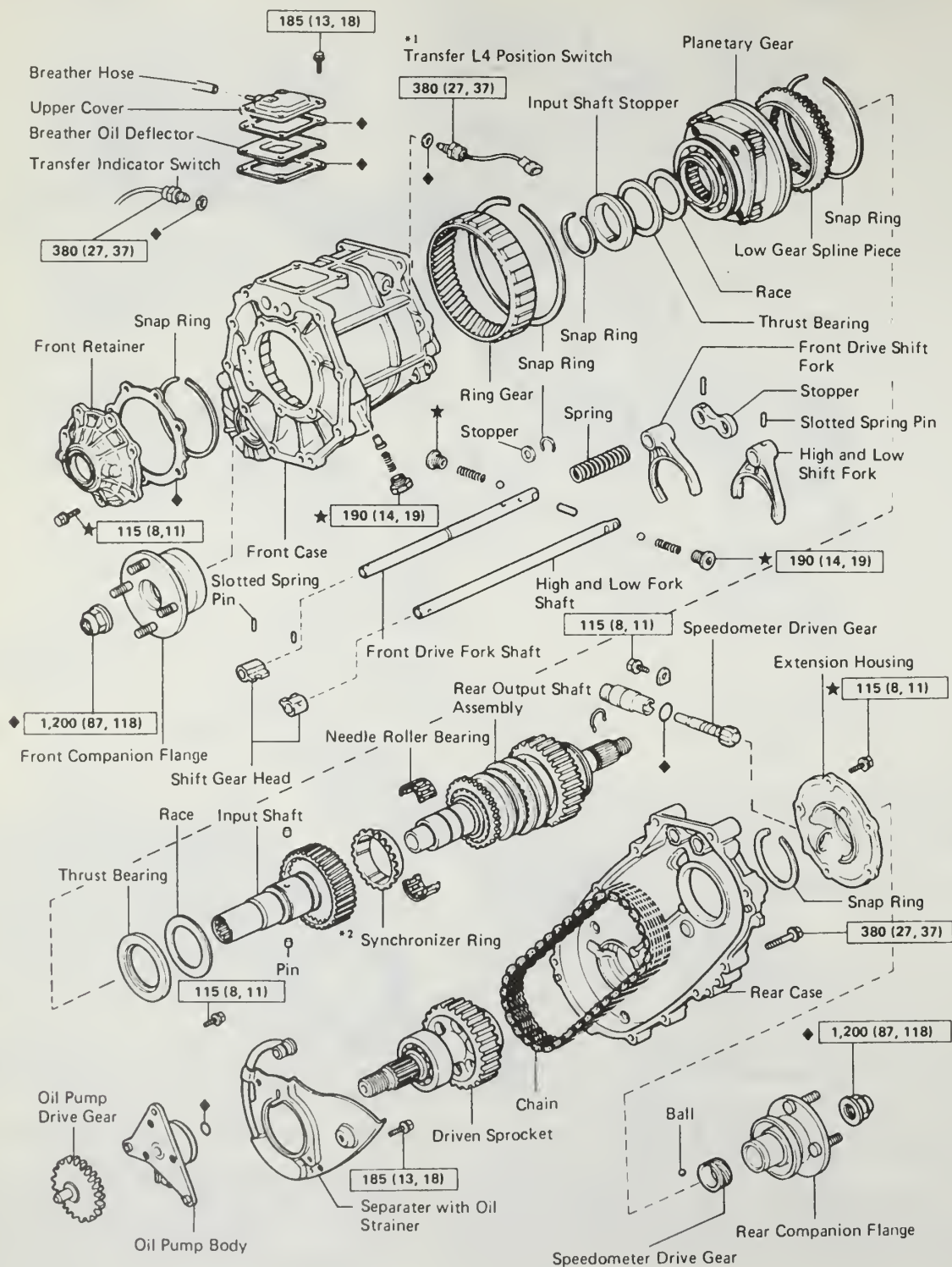
- ◆ Non-reusable part

★ Precoated part

VF1A transfer components as used with 3VZ-E and R150F

7 DRIVE TRAIN

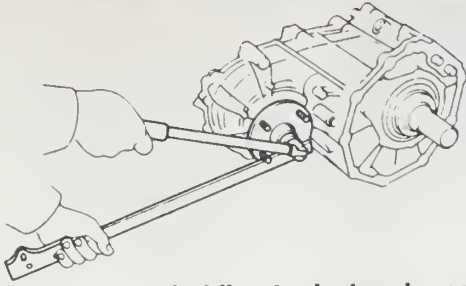
[22R-E/G58, A340F]



kg-cm (ft-lb, N-m) : Specified torque

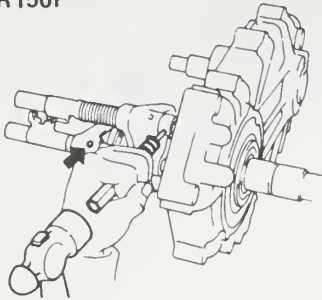
- ◆ Non-reusable part
- ★ Precoated part
- *1: A340F Automatic Transmission
- *2: G58 Manual Transmission

VF1A transfer components as used with 22R-E and either G58 or A340F

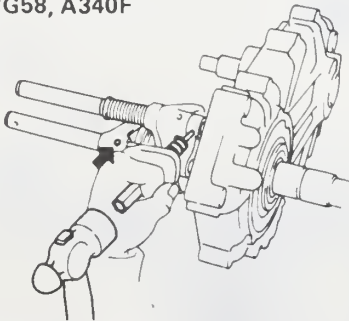


Always use a counterholding tool when loosening or tightening the companion flange

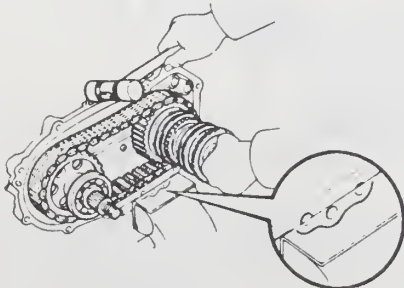
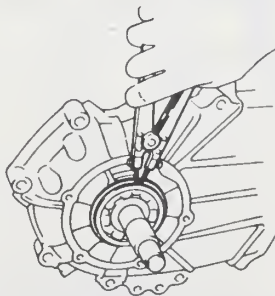
3VZ-E/R150F



22R-E/G58, A340F



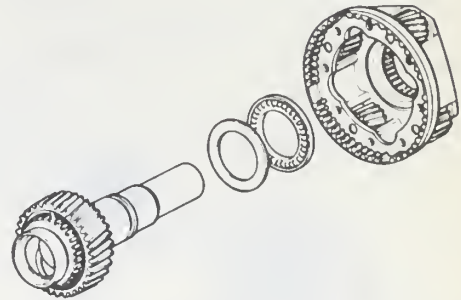
Removing the roll pins from the front drive fork shaft



Remove the rear case without damaging the rear output shaft or the chain drive



Remove the input shaft stopper, bearing and don't lose the small pins. Then remove the input shaft, bearing and race



race and the bearing into the planetary gear assembly. Install the input shaft into the planetary gear assembly.

31. Lightly oil the thrust bearing and washer and install them onto the input shaft. Install the two small pins onto the input shaft and then install the shaft stopper.

32. Select and install a snapping that will allow 0.05–0.15mm (0.0020–0.0059 in.) axial play.

33. Install the needle roller bearing into the input shaft.

34. Install the low gear spline piece to the planetary carrier. Install the snapping and align it so that the end gap is NOT aligned with the cutout portion of the carrier.

35. Install the planetary gear assembly with the input shaft and install the snapping.

36. Install the oil pump drive gear.

37. Install the oil pump body. Tighten the 3 bolts to 8 ft. lbs. (11 Nm).

38. Coat a new O-ring with gear oil and install it to the strainer pipe. Install the strainer and separator. Tighten the bolts to 13 ft. lbs. (18 Nm).

39. Apply multipurpose grease to the synchronizer ring for R150F or G58 units. Align the synchro ring slots with the shifting keys and install it on the HI/LO clutch hub.

40. Assemble the rear output shaft, driven sprocket and chain. Mount the rear case in a vise with protected jaws.

41. Install the rear output shaft, sprocket and chain into the rear case. Install the snapping.

42. Place the high and low speed shift forks into the groove of the hub sleeve. Install the fork shaft to the rear case through the shift fork and stopper.

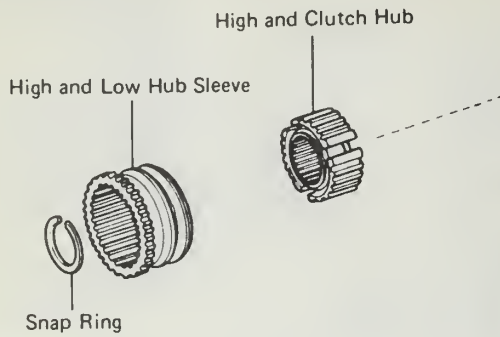
43. Lightly coat the straight pin with oil and install it into the case hole.

44. Place the front drive shift fork into the groove of the hub sleeve. Install the spring to the fork shaft.

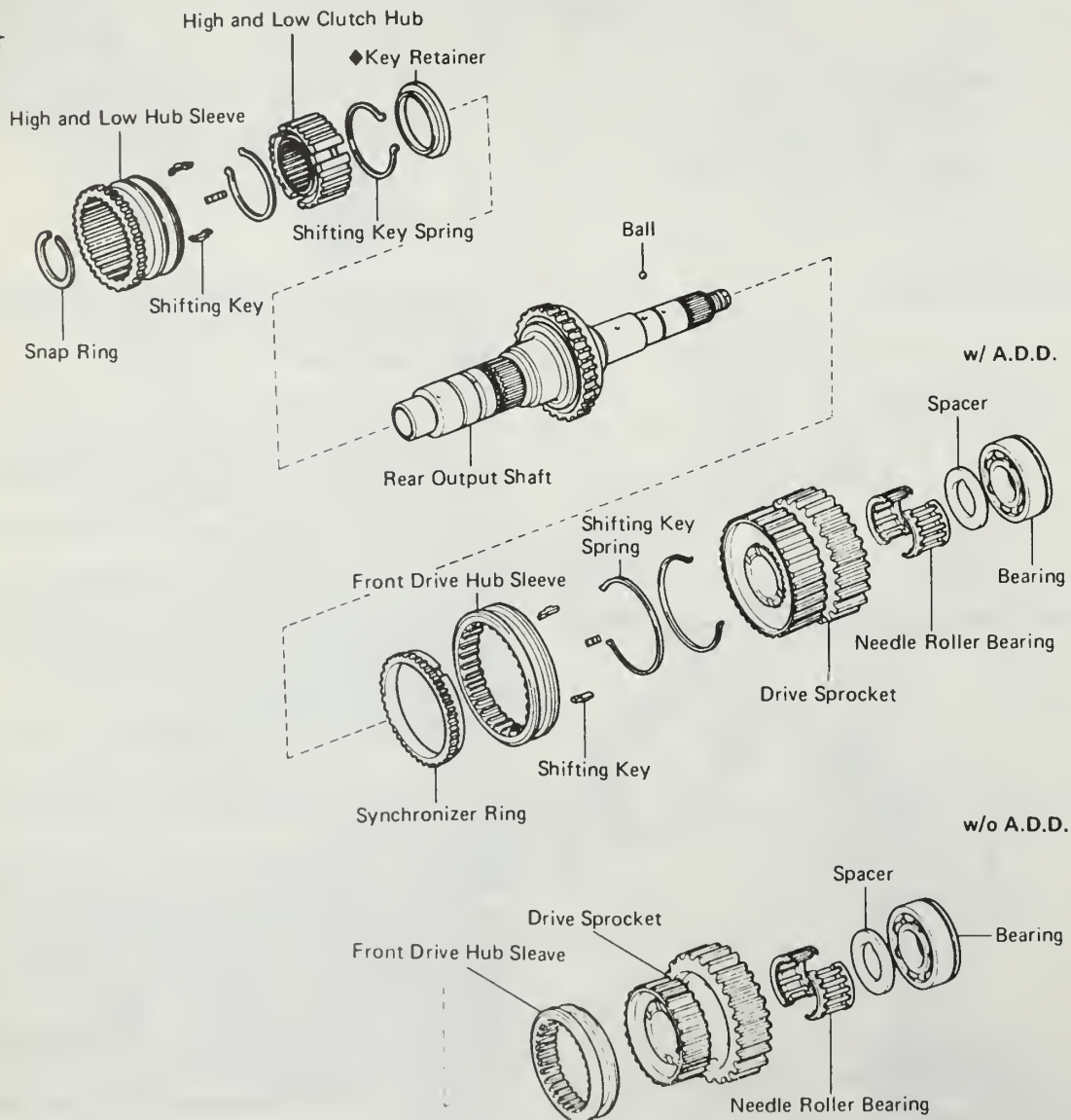
45. Install the fork shaft to the rear case through the shift fork and stopper. Use the pin punch and hammer to drive in the two slotted spring pins. The job will be much easier if you push the shaft towards the rear case and install the pin while the spring is compressed.

7 DRIVE TRAIN

AT

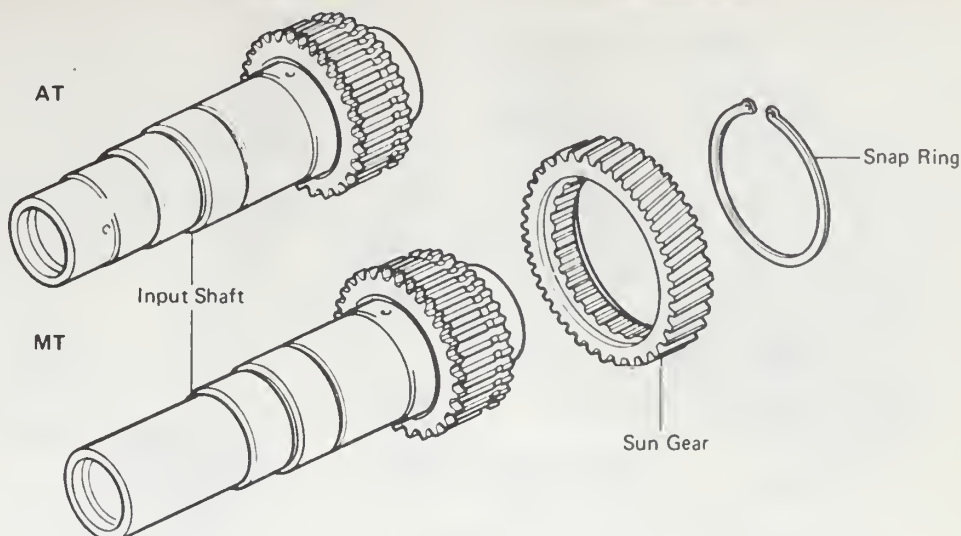


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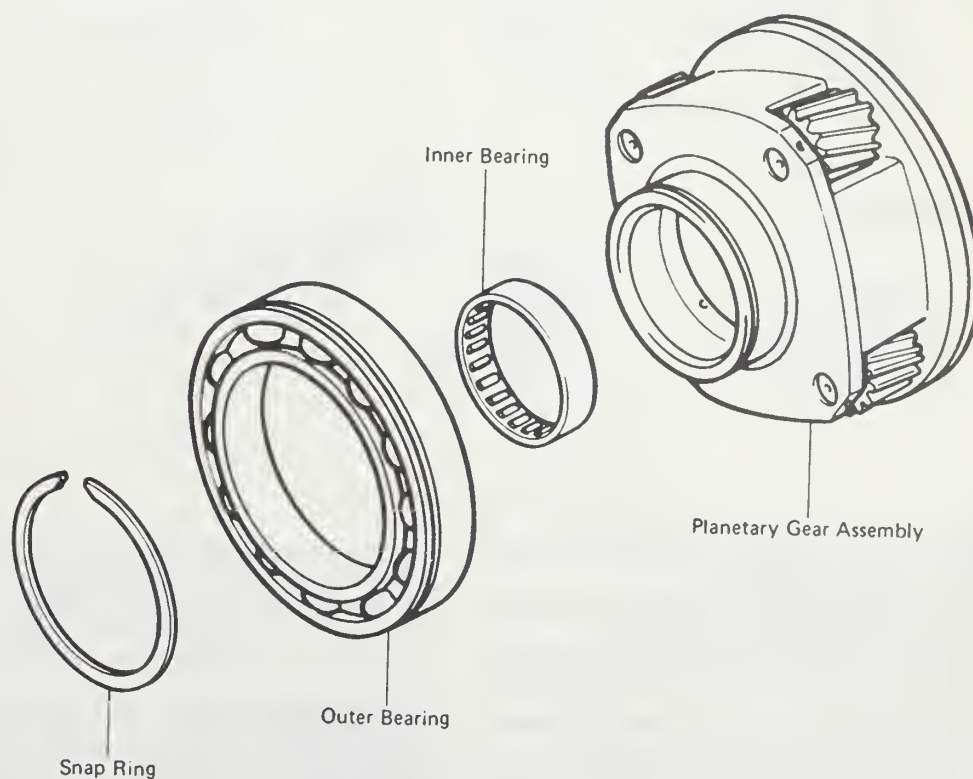


◆ Non reusable part

Rear output shaft components



Input shaft components



Planetary gear assembly

46. Install the ball and spring into each case hole. Apply sealer to the plugs and tighten them with the Torx® wrench to 14 ft. lbs. (19 Nm).

47. Apply a bead of sealant evenly around the mating face of the rear case. Keep the bead inside the bolt holes.

48. shift the HI/LO hub sleeve to the LO or rear side.

49. Assemble the front and rear cases. Install the 12 bolts and tighten them to 27 ft. lbs (37 Nm).

50. Install the speedometer drive gear; don't forget to install the ball on the rear output shaft.

51. Apply a bead of sealant to the mating surface of the extension housing. Install the housing to the rear case.

52. Apply liquid sealant to the 5 bolts; install the bolts and tighten them to 8 ft. lbs. (11 Nm).

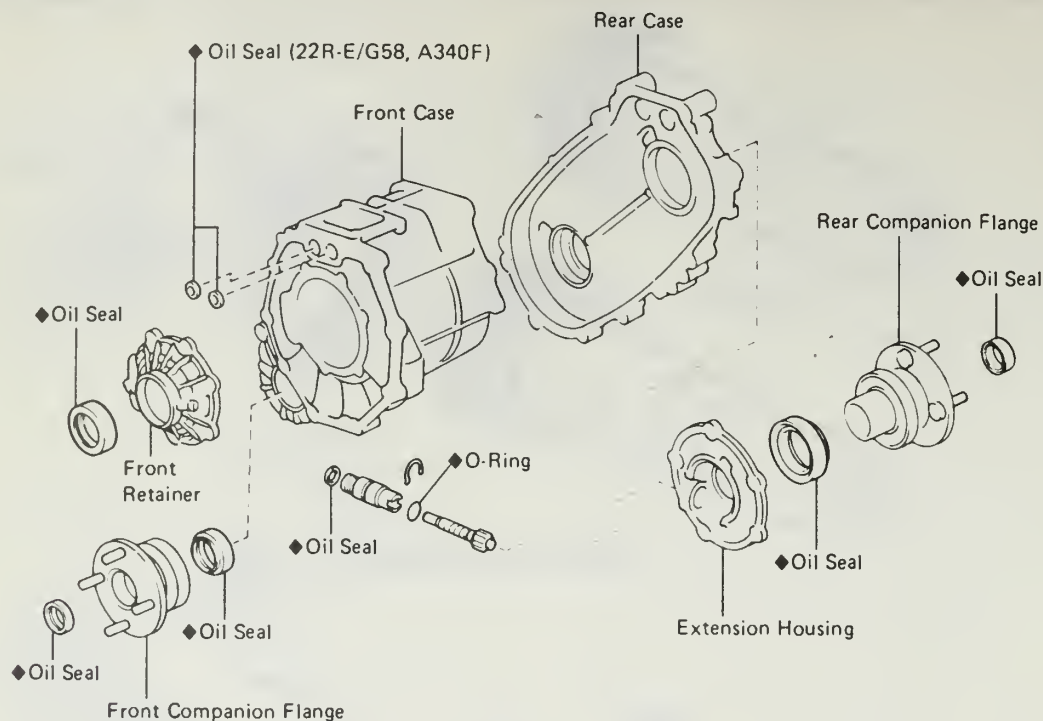
53. Apply gear oil to the inner surface of the front companion flange. Install the flange to the driven shaft.

54. Use a counterhold tool to secure the flange; install the lock nut and tighten it to 87 ft. lbs. (118 Nm). Stake the lock nut.

55. Repeat the procedure for the rear companion flange.

56. For 3VZ-E/R150F, install the selector return spring onto

7 DRIVE TRAIN



◆ Non-reusable part

Oil seals, VF1A transfer

the control retainer. Install a new gasket and install the retainer. Tighten the bolts to 13 ft. lbs. (18 Nm).

57. For 22R-E/G58 or A340F, install a new gasket on the case cover. Install the upper cover and the oil deflector.

58. Install a new gasket to the front retainer and install the retainer. Apply liquid sealer to the bolts and tighten them evenly to 8 ft. lbs. (11 Nm).

59. For 22R-E/G58 or A340F, install the two shift gear heads (Nos. 1 and 2) and drive in the two slotted spring pins.

60. Inspect the assembled unit, making sure that the input and output shafts rotate smoothly. Check that shifting can be made smoothly to all ranges or positions.

61. Install the transfer indicator switch and tighten it to 27 ft. lbs. (37 Nm).

62. Install the speedometer driven gear with its lock plate and bolt. Tighten the bolt to 8 ft. lbs. (11 Nm).

63. For 22R-E/340F, install the L4 position switch. Tighten it to 27 ft. lbs. (37 Nm).

HF2A

1. Remove the breather hose from the transfer case.
2. Remove the 4 bolts holding the motor actuator and remove the actuator.
3. Remove the output gear.

4. Use a Torx® T40 socket to remove the screw plug. Remove the spring and ball with a magnetic finger.

5. Remove the 4WD indicator switch.

6. Remove the front extension housing.

7. Remove the clutch sleeve, shift fork No. 2 and the fork shaft.

8. Use two screwdrivers and a hammer to remove the 3 snaprings; separate the shift fork from the No.2 shaft.

9. Remove the nine bolts and the rear extension housing.

10. Remove the oil strainer from the rear case.

11. Remove the case cover. After the 5 bolts are removed, use a brass bar and hammer to tap the cover loose.

12. Remove the snapping, the 8 bolts and separate the front and rear case. Separation may require tapping on the rear case with the brass bar and hammer.

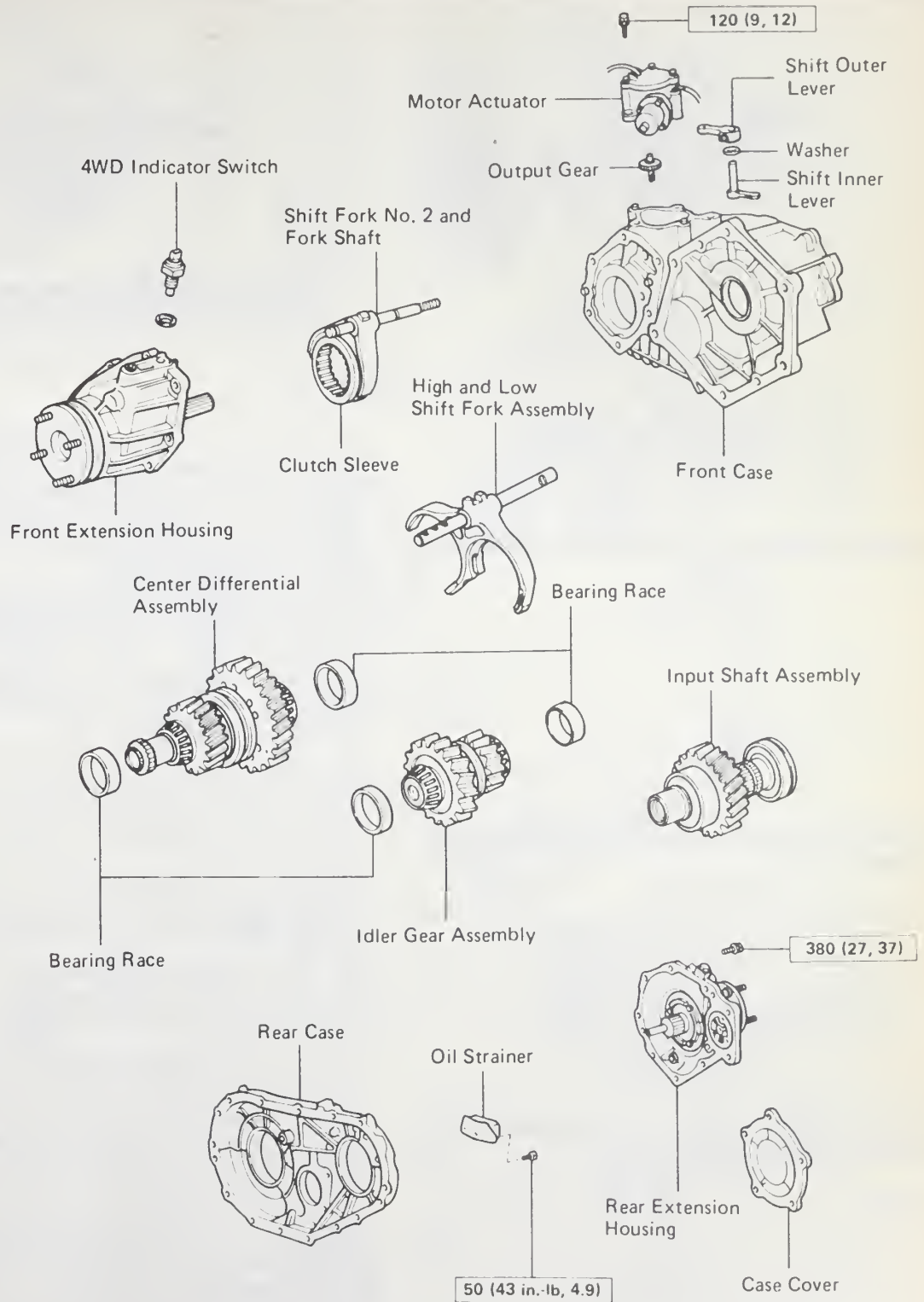
13. Remove the two bearing races from the rear case.

14. Remove the input shaft assembly.

15. Remove the idler gear assembly, center differential assembly and hi/low shift fork assembly.

16. Use a pin punch and hammer, remove the slotted spring pin and separate the shift fork from the No. 1 fork shaft.

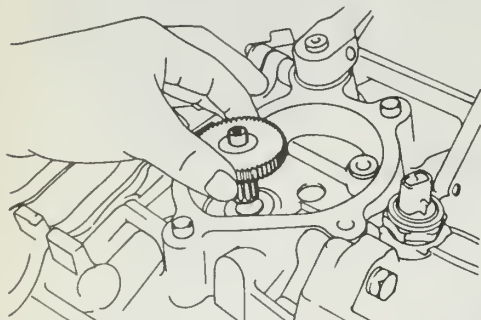
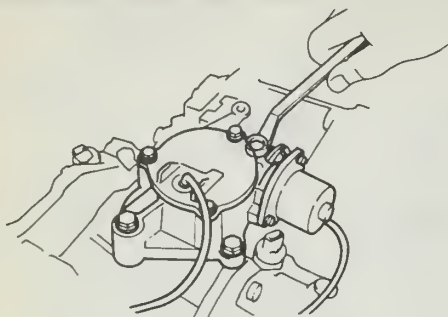
17. Remove the nut and washer holding the outer and inner levers. Tap out the lever lock pin using a brass bar, hammer and socket. Use the socket under the case. Remove the shift outer lever and inner lever.



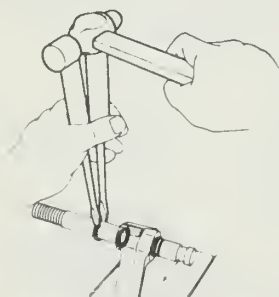
kg-cm (ft-lb, N·m) : Specified torque

HF2A transfer components

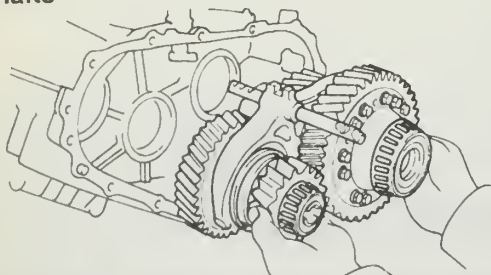
7 DRIVE TRAIN



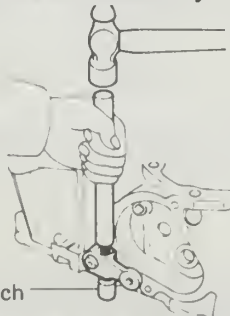
Remove the motor actuator and the output gear



This is one of the easier ways to remove snap rings from shafts

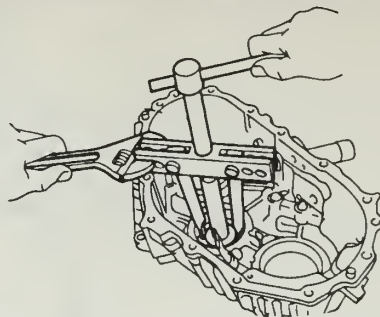


The idler gear, center differential assembly and low shift fork all come off as an assembly



Socket Wrench

Note the use of the socket when removing the shift lever pins



A puller of the correct size must be used when removing the race from the front case

18. If the oil seal at the lever is damaged, pry it out and install a new one using a seal driver of the correct diameter.

19. Inspect the input shaft oil seal. If damaged, replace it.

20. Remove the oil receiver from the front case.

21. Using an extractor such as tool 09950-20017 or equivalent, remove the bearing race from the front case. The other race may be removed with a brass drift.

22. Inspect the function of the transfer indicator switch. There should be continuity at the terminals when the switch is pushed in; in the free position, there should not be continuity.

To install:

23. Install the two bearing races into the front case. Use installation tools of the correct diameters. Incorrect tools or procedures may crack the case.

24. Install the oil receiver to the front case. Tighten the bolt only to 48 inch lbs. (5.4 Nm).

25. Install the shift outer lever and inner lever. Install the lever lock pin with the same tools used at removal. Install the washer and tighten the nut to 9 ft. lbs. (12 Nm.)

26. Assemble shift fork No. 1 and the fork shaft. Install the spring pin.

27. Install the idler gear assembly, center differential assembly and high/low shift fork assembly to the front case. Make certain the notch on the top of the shift fork engages the shift lever tab.

28. Install the input shaft assembly.

29. Install the two bearing races into the rear case.

30. Install the oil strainer to the rear case. Tighten the bolts to 43 inch lbs. (4.9 Nm).

31. Clean any remaining sealant from the mating surface of the front case. Once cleaned, keep the surface free of any oil or other pollutant. Apply an even bead of sealant to the front case, staying inboard of the bolt holes.

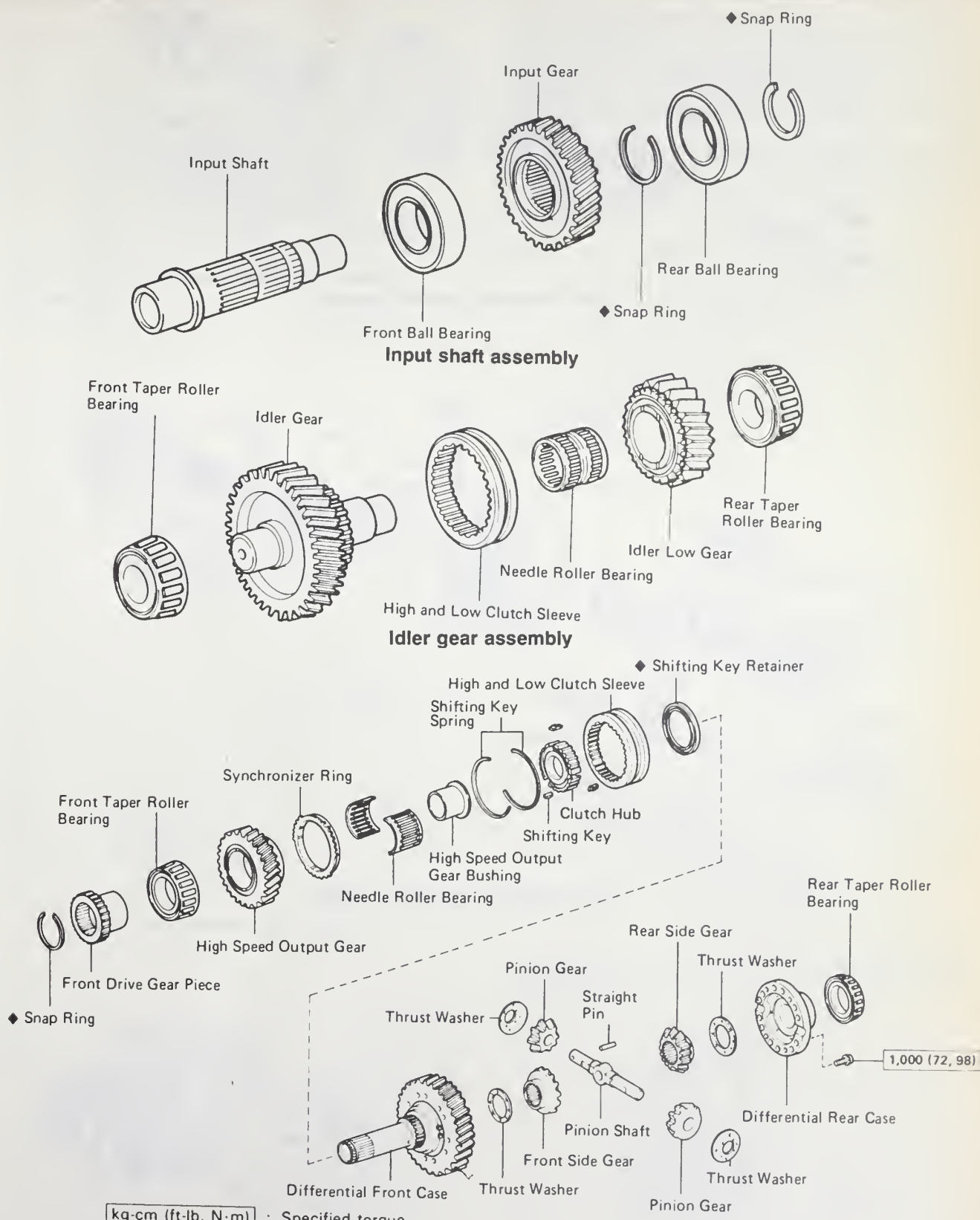
32. Install the front case. Install the 8 bolts. The two bolts in the "7 and 8 o'clock" positions should be coated with liquid sealant before installation. Tighten the bolts to 27 ft. lbs. (37 Nm).

33. Install the snapping.

34. Clean any remaining sealant from the mating surface of the rear case. Once cleaned, keep the surface free of any oil or other pollutant. Apply an even bead of sealant to the rear case, staying inboard of the bolt holes.

35. Install the rear case. Apply liquid sealer to the 5 bolts before installation. Tighten the bolts evenly to 27 ft. lbs. (37 Nm).

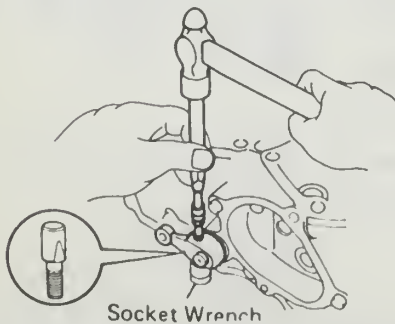
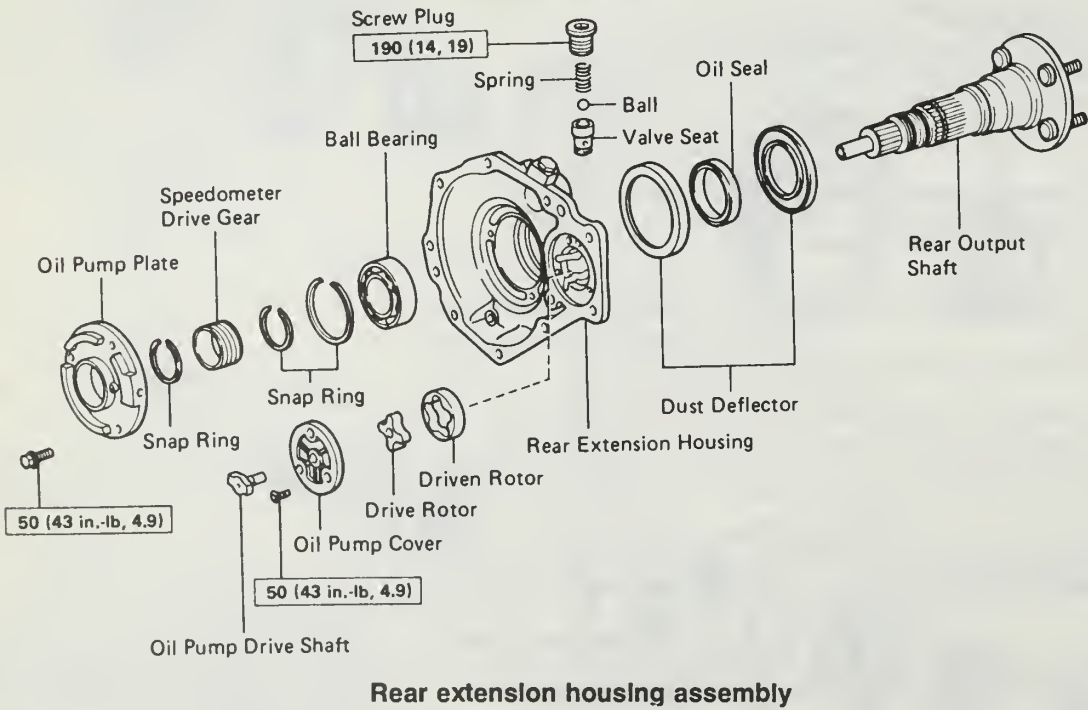
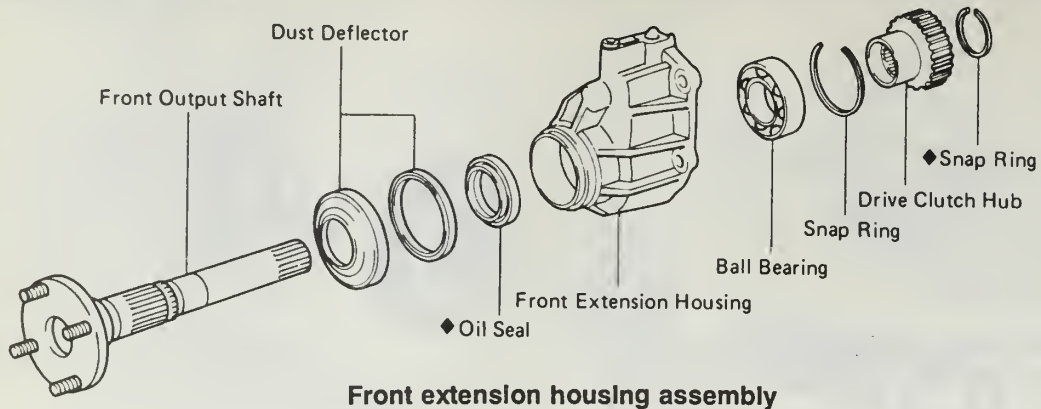
36. Select adjusting shims for the idler gear rear bearing. Lightly hold down the outer bearing race for the idler gear rear bearing. Use vernier calipers with a depth gauge to measure dimension A as shown. Measure dimension B as shown with a straight edge and a feeler gauge. Compute the required shim size as follows: Shim = A plus B plus 0.03-0.08mm. Use the table to select a shim within the range of the calculation.



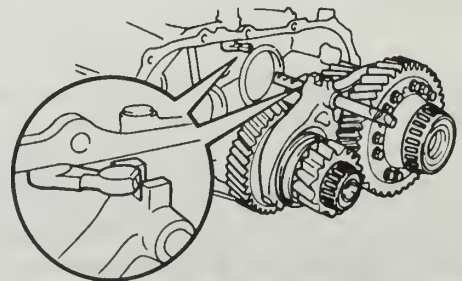
kg-cm (ft-lb, N·m) : Specified torque
◆ Non-reusable part

Center differential assembly

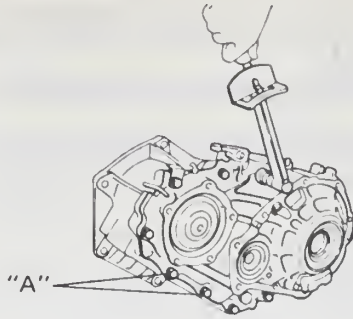
7 DRIVE TRAIN



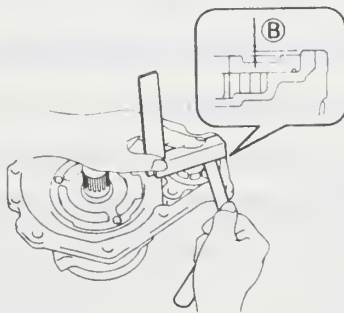
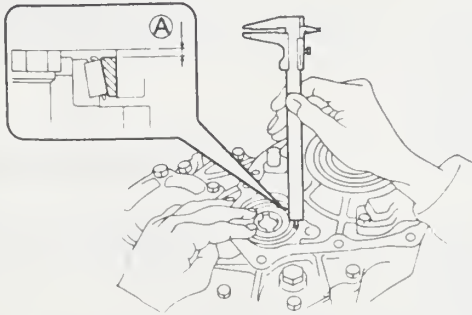
Reinstalling the shift lever pins



The upper tab must engage correctly during reinstallation



The 'A' bolts must be coated with sealant at reinstallation



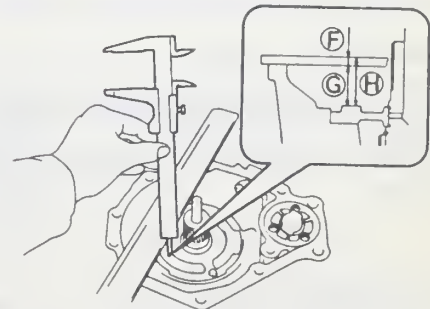
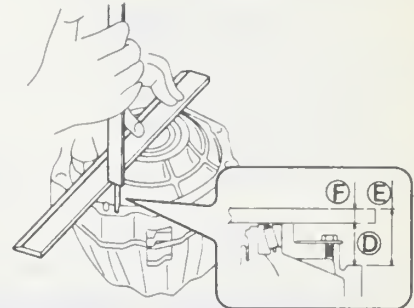
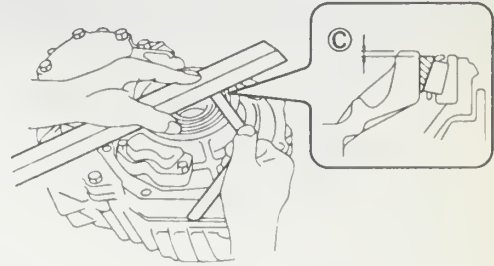
Measuring dimensions A and B

Mark	Thickness mm (in.)	Mark	Thickness mm (in.)
A	0.15 (0.0059)	G	3.00 (0.1181)
B	0.30 (0.0118)	H	3.20 (0.1260)
C	0.45 (0.0177)	J	3.40 (0.1339)
D	2.40 (0.0945)	K	3.60 (0.1417)
E	2.60 (0.1024)	L	3.80 (0.1496)
F	2.80 (0.1102)	M	4.00 (0.1575)

Use this table to select the shims for the Idler gear rear bearing

37. Select shims for the output shaft bearing. Lightly hold down the bearing outer race to eliminate any looseness. Measure dimension C as shown with a straight edge and a feeler gauge. Measure dimension D with a straight edge and depth gauge. (Hint: Dimension D can be computed by measuring the overall height, E, and subtracting the thickness of the straight edge, F.)

Measure dimension G. Compute the needed shim thickness using the formula: Shim = G - (D - C) plus 0.02–0.07mm. Use the table to select a shim within the range of the calculation.



Measuring the clearances on for the output shaft bearing

Mark	Thickness mm (in.)	Mark	Thickness mm (in.)
A	0.15 (0.0059)	G	1.60 (0.0630)
B	0.30 (0.0118)	H	1.80 (0.0709)
C	0.45 (0.0177)	J	2.00 (0.0787)
D	1.00 (0.0394)	K	2.20 (0.0866)
E	1.20 (0.0472)	L	2.40 (0.0945)
F	1.40 (0.0551)	M	2.60 (0.1024)

Use this table to select the shims for the output shaft bearing

7 DRIVE TRAIN

38. Apply a light coat of multipurpose grease to the shims selected and install them on the bearing outer races.
39. Install the oil pump driveshaft.
40. Clean any remaining sealant from the rear extension housing and keep the clean surface free of oil or other pollutants. Apply a bead of sealant around the mating surface, staying inboard of the bolt holes. Install the extension housing. Tighten the 9 bolts to 27 ft. lbs. (37 Nm).
41. Assemble the No. 2 shift fork and shaft; install the snaprings.
42. Install the clutch sleeve, shift fork No. 2 and shaft.
43. Clean the front extension housing of any sealant. Apply a bead of sealant on the mating surface, staying inboard of the bolt holes.

44. Set the clutch sleeve in the 4WD position and install the front extension housing. Install the 6 bolts and tighten them to 27 ft. lbs. (37 Nm).
45. Install the 4WD indicator switch. Tighten it to 27 ft. lbs. (37 Nm).
46. Install the ball and spring. Apply liquid sealer to the screw plug and install it, tightening it to 14 ft. lbs. (19 Nm).
47. Apply a light coat of gear oil to the output gear and install the gear.
48. Set the differential actuator motor in the lock position. Clean the mating surfaces of any remaining sealant and install a thin, even bead of new sealer to the front case. Install the motor actuator and tighten the bolts to 9 ft. lbs. (12 Nm).
49. Install the breather hose on the case.

DRIVELINE

Front Driveshaft and Universal Joints

REMOVAL AND INSTALLATION

4WD Models Only

1. Jack up the front of the truck and support with jackstands.
2. Paint a mating mark on the two halves of the rear universal joint flange.
3. Remove the bolts which hold the rear flange to the front of the transfer case.

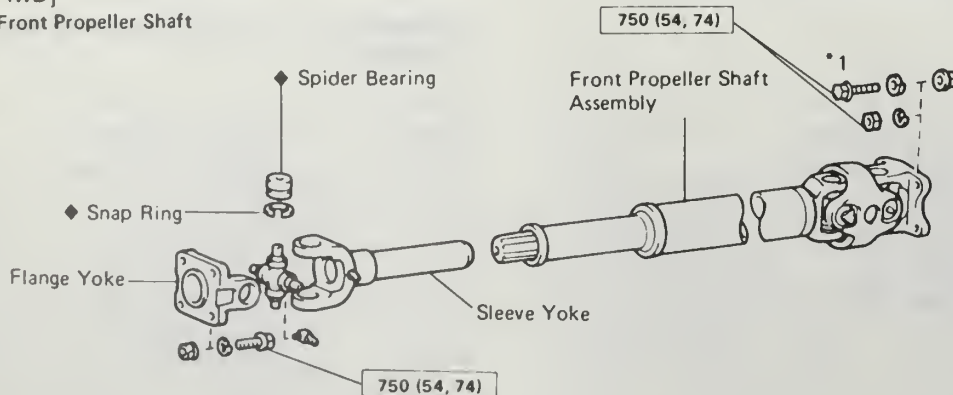
4. Paint a mating mark on the two halves of the front universal joint flange.
5. Remove the bolts which hold the front flange to the front differential.
6. Remove the front driveshaft.

To install:

7. Position the driveshaft so that the paint marks made previously line up.
8. Install the flange bolts and tighten to 54 ft. lbs. (74 Nm).
9. Lower the vehicle and road test it.

[4WD]

Front Propeller Shaft



Front drive shaft — Trucks

DRIVELINE

Troubleshooting Basic Driveshaft and Rear Axle Problems

When abnormal vibrations or noises are detected in the driveshaft area, this chart can be used to help diagnose possible causes. Remember that other components such as wheels, tires, rear axle and suspension can also produce similar conditions.

BASIC DRIVESHAFT PROBLEMS

Problem	Cause	Solution
Shudder as car accelerates from stop or low speed	• Loose U-joint • Defective center bearing	• Replace U-joint • Replace center bearing
Loud clunk in driveshaft when shifting gears	• Worn U-joints	• Replace U-joints
Roughness or vibration at any speed	• Out-of-balance, bent or dented driveshaft • Worn U-joints • U-joint clamp bolts loose	• Balance or replace driveshaft • Replace U-joints • Tighten U-joint clamp bolts
Squeaking noise at low speeds	• Lack of U-joint lubrication	• Lubricate U-joint; if problem persists, replace U-joint
Knock or clicking noise	• U-joint or driveshaft hitting frame tunnel • Worn CV joint	• Correct overloaded condition • Replace CV joint

BASIC REAR AXLE PROBLEMS

First, determine when the noise is most noticeable.

Drive Noise — Produced under vehicle acceleration.

Coast Noise — Produced while the car coast with a closed throttle.

Float Noise — Occurs while maintaining constant car speed (just enough to keep speed constant) on a level road.

Road Noise

Brick or rough surfaced concrete roads produce noises that seem to come from the rear axle. Road noise is usually identical in Drive or Coast and driving on a different type of road will tell whether the road is the problem.

Tire Noise

Tire noises are often mistaken for rear axle problems. Snow treads or unevenly worn tires produce vibrations seeming to originate elsewhere. Temporarily inflating the tire to 40 lbs will significantly alter tire noise, but will have no effect on rear axle noises (which normally cease below about 30 mph).

Engine/Transmission Noise

Determine at what speed the noise is more pronounced, then stop the car in a quiet place. With the transmission in Neutral, run the engine through speeds corresponding to road speeds where the noise was noticed. Noises produced with the car standing still are coming from the engine or transmission.

Front Wheel Bearings

While holding the car speed steady, lightly apply the foot brake; this will often decrease bearing noise, as some of the load is taken from the bearing.

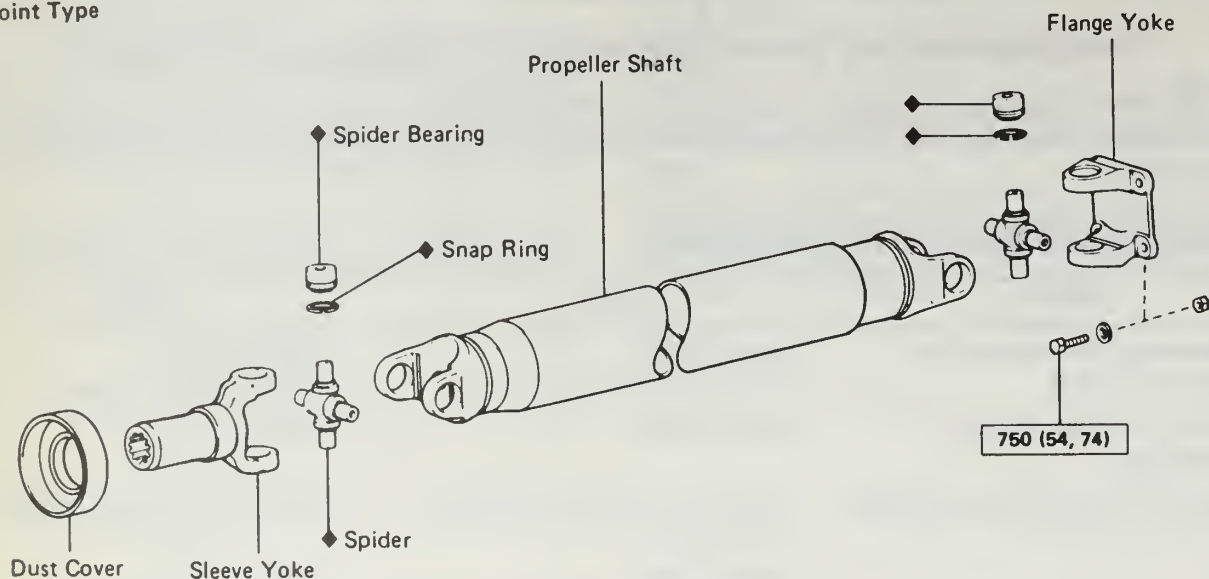
Rear Axle Noises

Eliminating other possible sources can narrow the cause to the rear axle, which normally produces noise from worn gears or bearings. Gear noises tend to peak in a narrow speed range, while bearing noises will usually vary in pitch with engine speeds.

7 DRIVE TRAIN

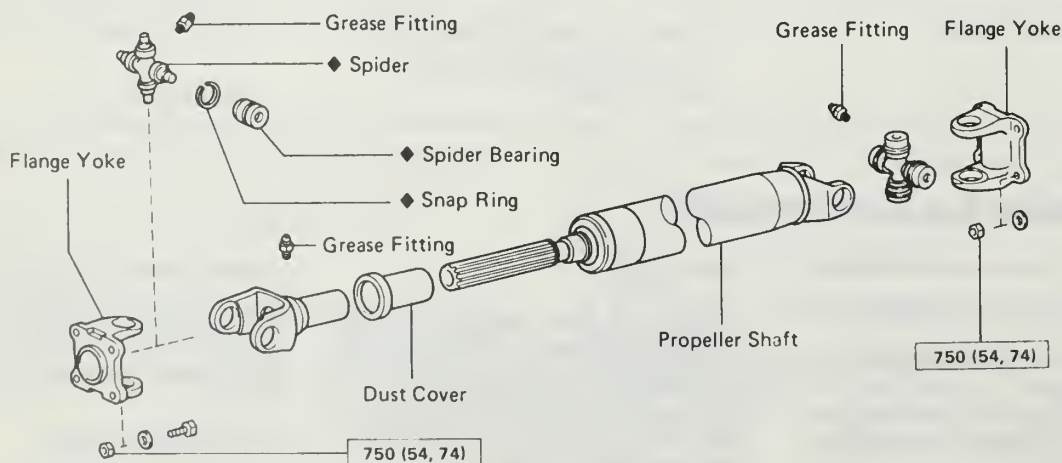
[2WD]

2 - Joint Type



Front drive shaft — 4Runner

• Front Propeller Shaft



Front drive shaft — Land Cruiser

UNIVERSAL JOINT (SPIDER JOINT) OVERHAUL

1. Matchmark the yoke and the driveshaft.
2. Remove the snaprings from the bearings.
3. Position the yoke on vise jaws. Using a bearing remover and a hammer, gently tap the remover until the bearing is driven out of the yoke about 25mm.
4. Place the tool in the vise and drive the yoke away from the tool until the bearing is removed.
5. Repeat Steps 3 and 4 for the other bearings.
6. Check for worn or damaged parts. Inspect the bearing journal surfaces for wear.

To assemble:

7. Install the bearing cups, seals, and O-rings in the spider.
8. Grease the spider and the bearings.
9. Position the spider in the yoke.

10. Start the bearings in the yoke and then press them into place, using a vise.

11. Repeat Step 4 for the other bearings.

12. If the axial play of the spider is greater than 0.05mm, select snaprings which will provide the correct play. Be sure that the snaprings are the same size on both sides or driveshaft noise and vibration will result.

13. Check the U-joint assembly for smooth operation.

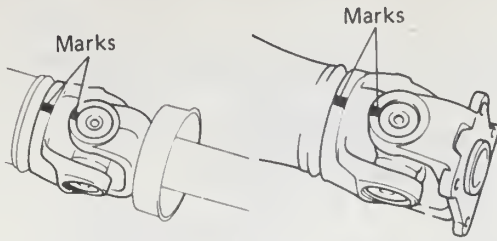
Rear Driveshaft and U-Joints

REMOVAL AND INSTALLATION

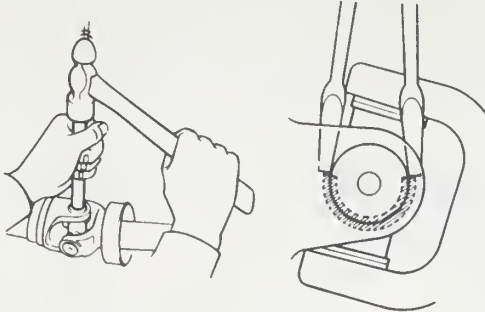
2WD Pickup

ONE-PIECE DRIVESHAFT

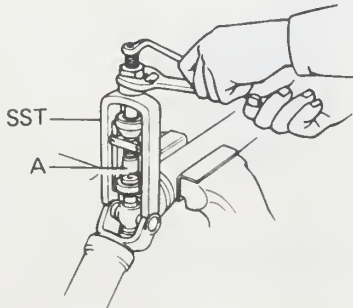
1. Jack up the rear of the truck and support the rear axle housing with jackstands.



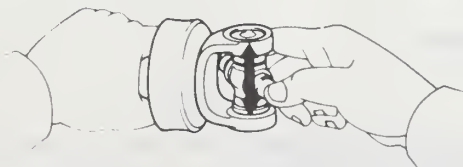
Always place matchmarks on the spider and the yoke



Remove the snap rings



Use a bearing extractor to remove the spider bearings



Check the axial play after reassembly

2. Paint a mating mark on the two halves of the rear universal joint flange.
3. Remove the bolts which hold the rear flange together.
4. Remove the splined end of the driveshaft from the transmission.

NOTE: Plug the end of the transmission with a rag or other device to prevent oil loss.

5. Remove the driveshaft from under the truck.

To install:

6. Apply multipurpose grease to the splined end of the shaft.
7. Insert the driveshaft sleeve into the transmission.

NOTE: Be careful not to damage the extension housing grease seal.

8. Align the mating marks on the rear flange and replace the bolts. Tighten to 54 ft. lbs. (74 Nm) on all vehicles except trucks with 3VZ-E and manual transmissions: 56 ft. lbs. (76 Nm).

9. Remove the jackstands and lower the vehicle.

TWO-PIECE DRIVESHAFT W/CENTER BEARING

1. Jack up the rear of the truck and support the rear axle housing on jackstands.

2. Before you begin to disassemble the driveshaft components, you must first paint accurate alignment marks on the mating flanges. Do this on the rear universal joint flange, the center flange, and on the transmission flange.

3. Remove the bolts attaching the rear universal joint flange to the drive pinion flange.

4. Drop the rear section of the shaft slightly and pull the unit out of the center bearing sleeve yoke.

5. Remove the center bearing support from the crossmember.

6. Separate the transmission output flange and remove the front half of the driveshaft together with the center bearing assembly.

To install:

7. Connect the output flange of the transmission to the flange on the front half of the shaft.

8. Install the center bearing support to the crossmember, but do not fully tighten the bolts.

9. Install the rear section of the shaft making sure that all mating marks are aligned.

10. Tighten all flange bolts to 22-36 ft. lbs.

4WD Pickup and 4Runner

1. Raise the vehicle and support it with jackstands.

2. Matchmark all driveshaft flanges **BEFORE** removing any bolts.

3. Disconnect the driveshaft flange at the companion flange on the differential.

4. Remove the center bearing from the frame crossmember.

5. Disconnect the front flange at the companion flange on the rear of the transfer case and remove the driveshaft.

6. Separate the front portion of the shaft at the intermediate shaft flange.

7. Disconnect the rear of the driveshaft at the center bearing flange.

8. Using a hammer and chisel, loosen the staked portion of the center bearing nut and then remove the nut. Matchmark the flange to the intermediate shaft and then pull the bearing off the shaft.

To install:

9. Install the center bearing on the intermediate shaft and tighten the nut to 134 ft. lbs. (181 Nm), loosen the nut and then retighten it to 51 ft. lbs. (69 Nm). Stake the nut.

10. Connect the front portion of the driveshaft to the intermediate shaft and the rear portion to the center flange. Make sure the marks all line up and then tighten the bolts to 54 ft. lbs. (74 Nm).

11. Connect the rear flange to the differential flange and tighten the bolts to 54 ft. lbs. (74 Nm).

12. Connect the front flange to the transfer case flange and tighten the bolts to 54 ft. lbs. (74 Nm).

13. Mount the center bearing on the crossmember and tighten the mounting bolts to 27 ft. lbs. (36 Nm).

14. Lower the vehicle and give it a road test.

Land Cruiser

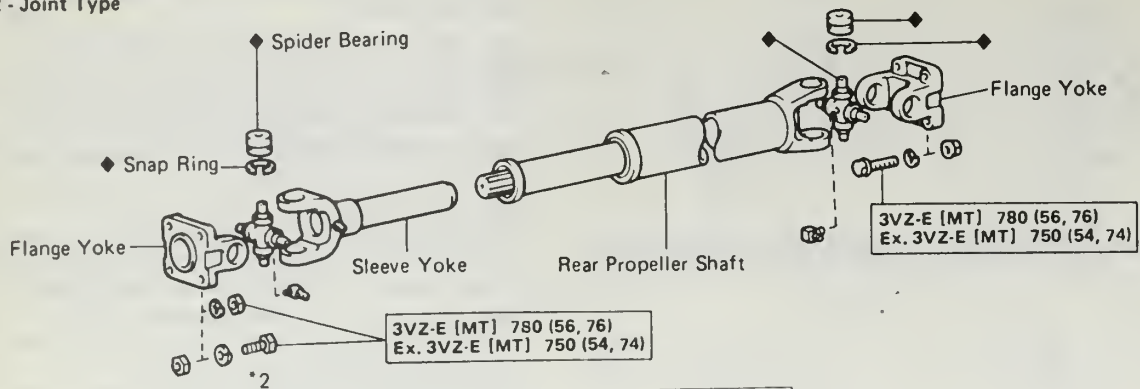
1. Raise the vehicle and support it with jackstands.

2. Matchmark all driveshaft flanges **BEFORE** removing the bolts.

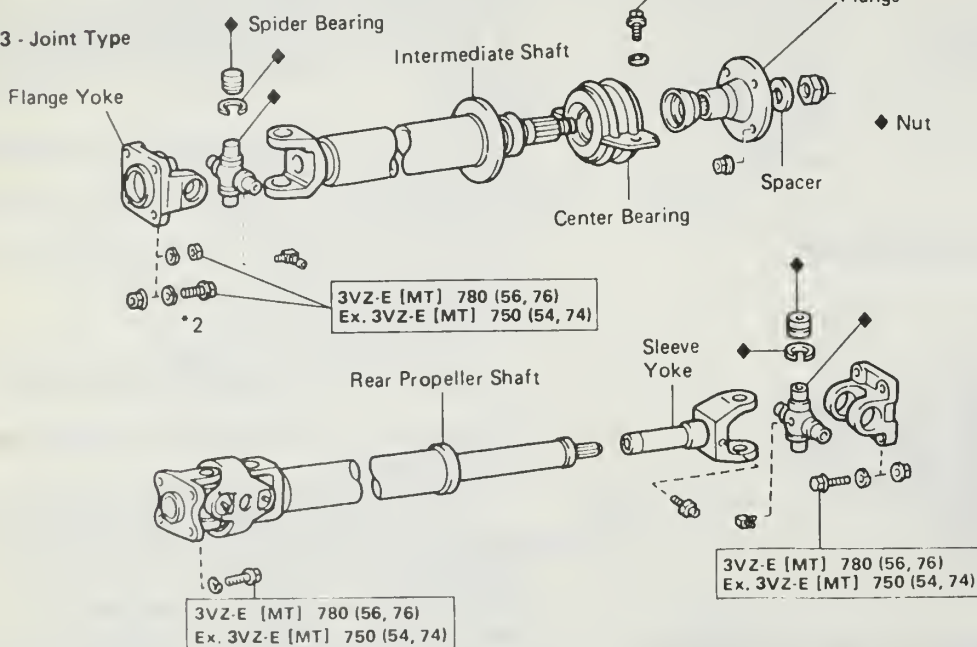
3. Unfasten the bolts which secure the universal joint flange to the differential pinion flange.

7 DRIVE TRAIN

Rear Propeller Shaft 2 - Joint Type



3 - Joint Type



kg-cm (ft-lb, N·m) : Specified torque

◆ Non reusable part

*1: w/ RF1A Type Transfer

*2: w/ RF1A Type Transfer and A340H Automatic Transmission

Rear drive shaft — 4WD trucks

4. Perform Step 2 for the U-joint-to-transfer case flange bolts.

5. Withdraw the driveshaft from beneath the vehicle.

NOTE: Lubricate the U-joints and sliding joints with multipurpose grease before installation.

6. Position the driveshaft so that all paint marks line up and then tighten the flange bolts to 65 ft. lbs. (88 Nm).

7. Lower the vehicle and road test it.

U-JOINT OVERHAUL

1. Matchmark the yoke and the driveshaft.

2. Remove the snaprings from the bearings.

3. Position the yoke on vise jaws. Using a bearing remover and a hammer, gently tap the remover until the bearing is driven out of the yoke about 25mm.

4. Place the tool in the vise and drive the yoke away from the tool until the bearing is removed.

5. Repeat Steps 3 and 4 for the other bearings.

6. Check for worn or damaged parts. Inspect the bearing journal surfaces for wear.

To assemble:

7. Install the bearing cups, seals, and O-rings in the spider.

8. Grease the spider and the bearings.

9. Position the spider in the yoke.

10. Start the bearings in the yoke and then press them into place, using a vise.

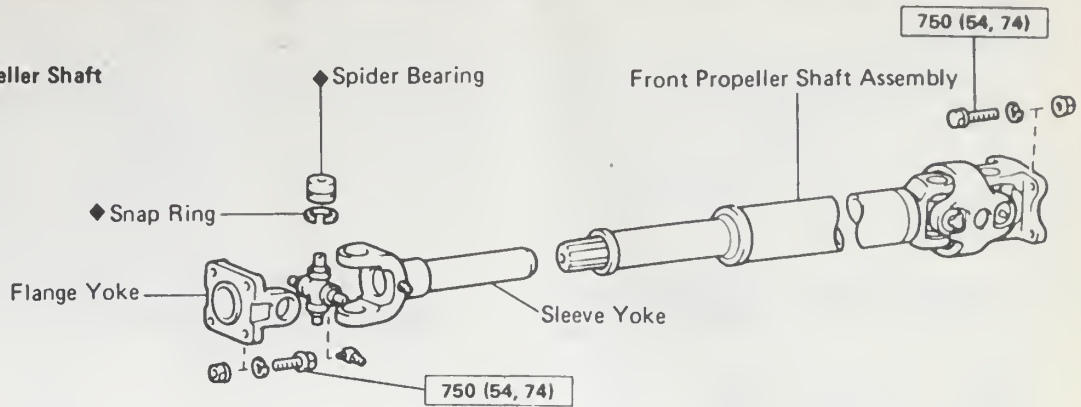
11. Repeat Step 4 for the other bearings.

12. If the axial play of the spider is greater than 0.05mm, select snaprings which will provide the correct play. Be sure that the snaprings are the same size on both sides or driveshaft noise and vibration will result.

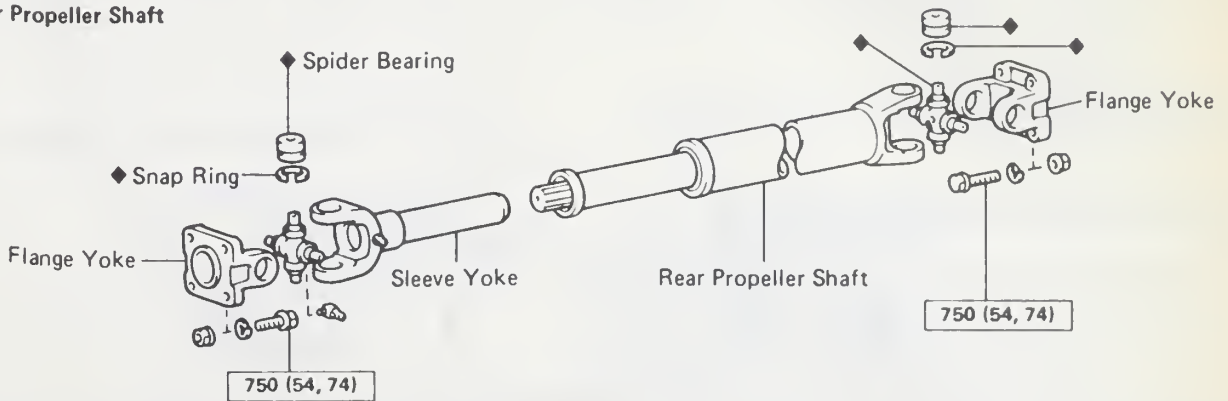
13. Check the U-joint assembly for smooth operation.

[4WD]

Front Propeller Shaft

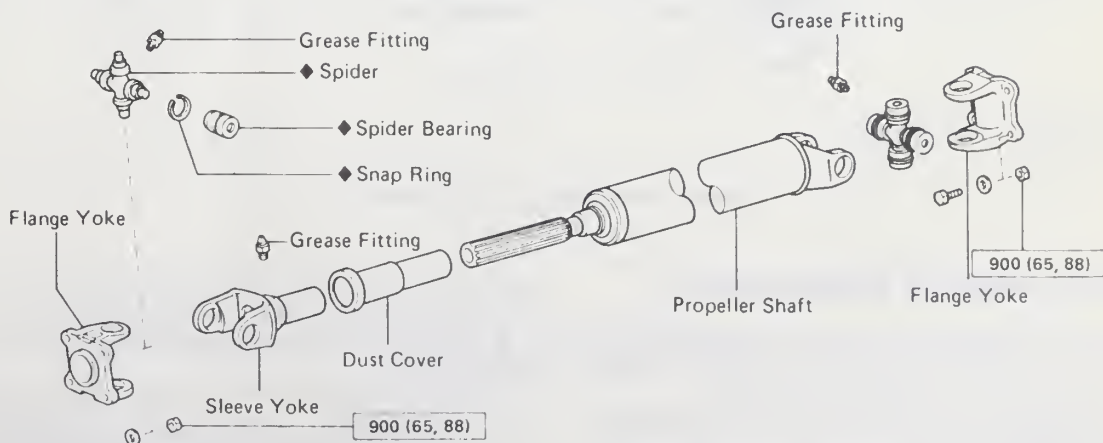


Rear Propeller Shaft



Rear drive shaft – 4Runner

• Rear Propeller Shaft

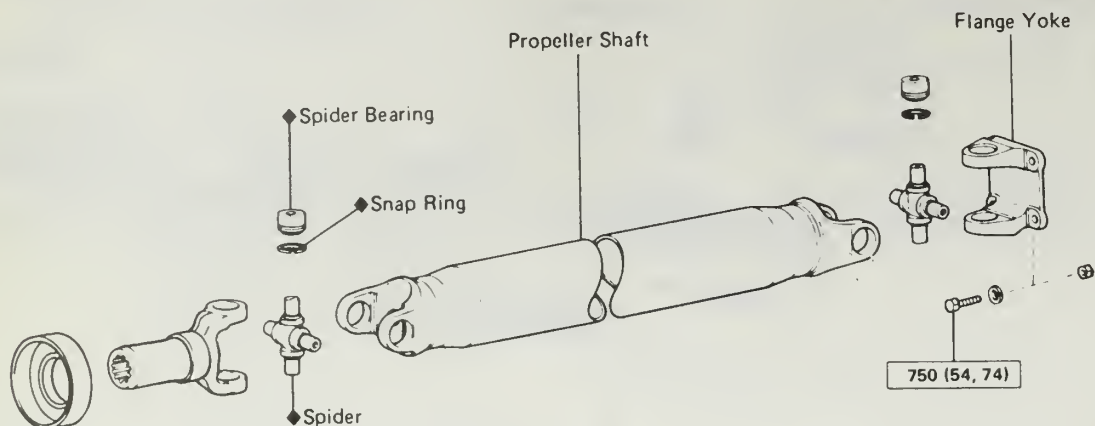


Rear drive shaft – Land Cruiser

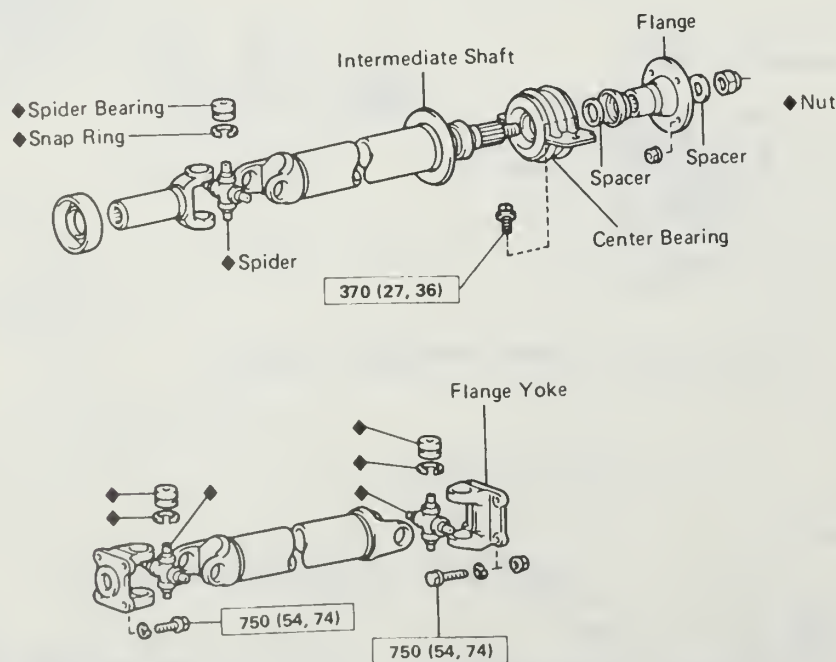
7 DRIVE TRAIN

[2WD]

2 - Joint Type



3 - Joint Type



kg-cm (ft-lb, N-m)

Specified torque

◆ Non-reusable part

Rear drive Shaft – 2WD trucks

Center Bearing Replacement

The center support bearing is a sealed unit which requires no periodic maintenance. The following procedure should be used if it should become necessary to replace the bearing.

1. Remove the intermediate driveshaft and the center support bearing assembly.
2. Paint mating marks on the universal joint flange and the intermediate driveshaft.
3. Remove the cotter pin and castle nut from the intermedi-

ate driveshaft—the nut will be staked. Remove the universal joint flange from the driveshaft using a press.

4. Remove the center support bearing assembly from the driveshaft.

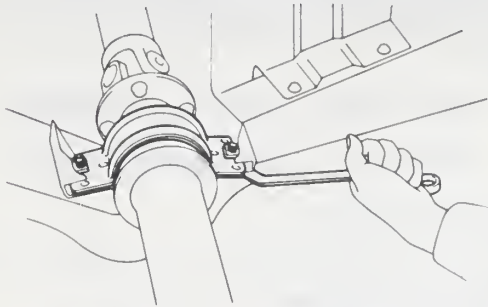
5. Remove the two bolts from the bearing housing and remove the housing.

6. Remove the dust deflectors from both sides of the bearing cushion. Remove the dust deflectors from either side of the bearing.

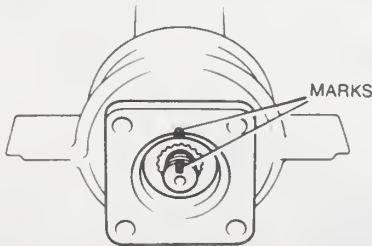
7. Remove the snaprings from each side of the bearing. This



Always matchmark the flanges prior to removal



Remove the center support bearing bolts

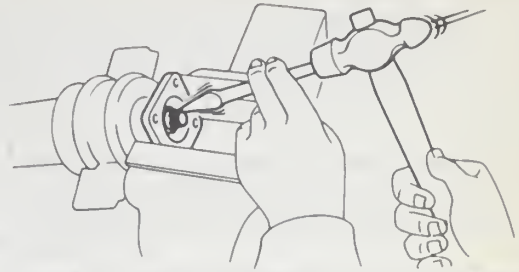


After removing the retaining nut, slide the center support bearing and the flange off the intermediate shaft. Note the use of matchmarks here, too

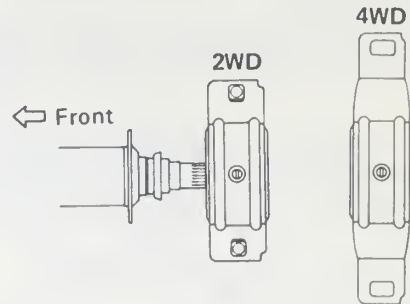
is easy to do if you have a snapping tool which fits the holes in the ring, and very difficult otherwise. Remove the bearing.
To assemble:

8. Install the new bearing into the cushion and fit a snapping on each side.

9. Apply a coat of multipurpose grease to the dust deflectors



Once installed, use a hammer and punch to stake the center support bearing retaining nut



Correct position of the center support bearing is critical

and put them in their respective places on each side of the bearing. The single deflector with a slightly larger diameter goes on the rear of the bearing.

10. Press the dust deflector onto each side of the cushion. The water drain holes in the deflectors should be in the same position on each side of the cushion. The water drain holes should face the bottom of the housing.

11. Press the support bearing assembly firmly onto the intermediate driveshaft, with the seal facing front.

12. Match the mating marks painted earlier, and install the universal joint flange to the driveshaft. Install the center bearing on the intermediate shaft and tighten the nut to 134 ft. lbs. (181 Nm), loosen the nut and then retighten it to 51 ft. lbs. (69 Nm). Stake the nut.

NOTE: Check to see if the center support bearing assembly will rotate smoothly around the driveshaft.

13. When reinstalling the driveshaft, be certain to match up the marks on both the front transmission flange and the flange on the sleeve yoke of the rear driveshaft.

REAR DRIVE AXLE

Understanding Drive Axles

The drive axle is a special type of transmission that reduces the speed of the drive from the engine and transmission and di-

vides the power to the wheels. Power enters the axle from the driveshaft via the companion flange. The flange is mounted on the drive pinion shaft. The drive pinion shaft and gear which carry the power into the differential turn at the speed of the

7 DRIVE TRAIN

transmission output shaft. The gear on the end of the pinion shaft drives a large ring gear whose axis of rotation is 90° away from the of the pinion. The pinion and gear reduce the gear ratio of the axle, and change the direction of rotation to turn the axle shafts which drive both wheels. The axle gear ratio is found by dividing the number of pinion gear teeth into the number of ring gear teeth.

The ring gear drives the differential case. The case provides the two mounting points for the ends of a pinion shaft on which are mounted two pinion gears. The pinion gears drive the two side gears, one of which is located on the inner end of each axle shaft.

By driving the axle shafts through this arrangement, the differential allows the outer drive wheel to turn faster than the inner drive wheel in a turn.

The main drive pinion and the side bearings, which bear the weight of the differential case, are shimmed to provide proper bearing preload, and to position the pinion and ring gears properly.

WARNING: The proper adjustment of the relationship of the ring and pinion gears is critical. It should be attempted only by those with extensive equipment and/or experience. Doing it incorrectly is noisy and expensive.

Determining Axle Ratio

The drive axle of a vehicle is said to have a certain axle ratio.

This number (usually a whole number and a decimal fraction) is actually a comparison of the number of gear teeth on the ring gear and the pinion gear. For example, a 4.11 rear means that, in theory, there are 4.11 teeth on the ring gear and one tooth on the pinion gear or, put another way, the driveshaft must turn 4.11 times to turn the wheels once. There might be 37 teeth on the ring gear and 9 teeth on the pinion gear. By dividing the number of teeth on the ring gear, the numerical axle ratio (4.11) is obtained.

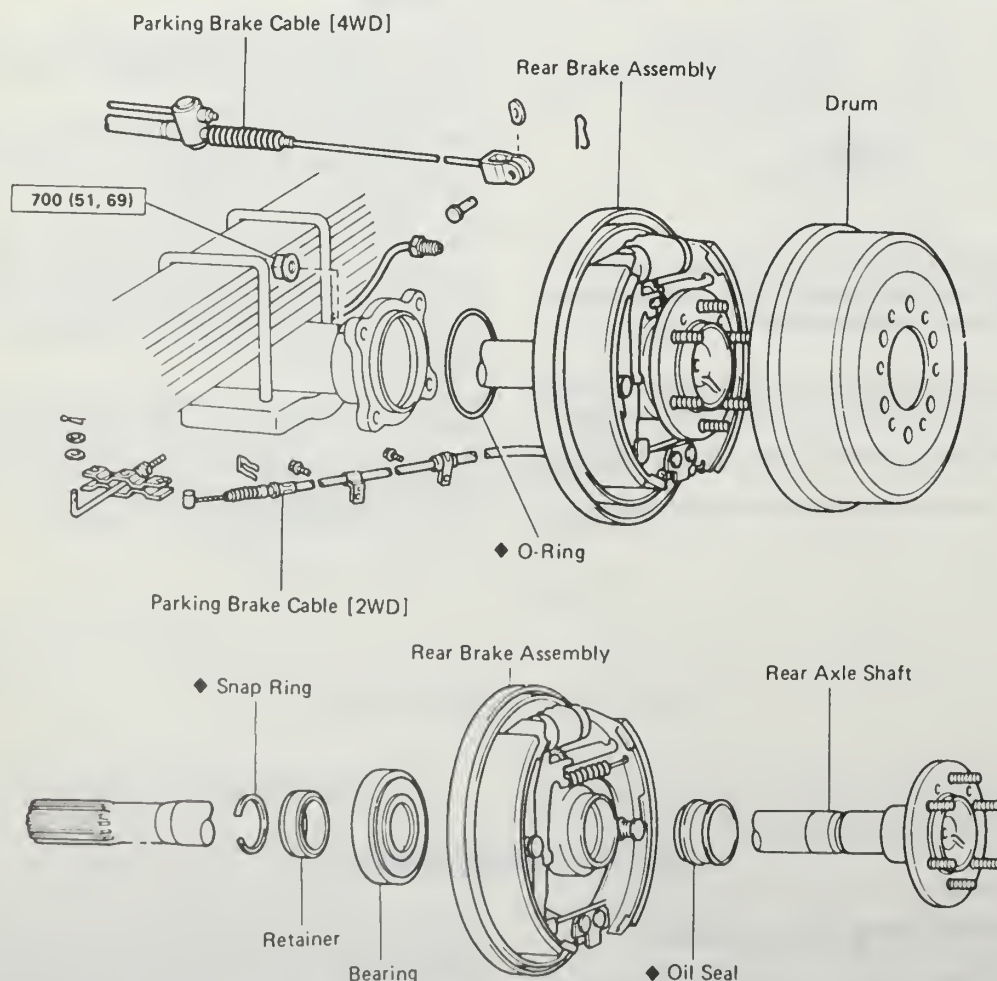
Another method of determining gear ratio is to jack up and support the truck so that both rear wheels are off the ground. Make a chalk mark on the rear wheel and the driveshaft. Put the transmission in neutral. Turn the rear wheel one complete turn and count the number of turns that the driveshaft makes. The number of turns that the driveshaft makes in one complete revolution of the rear wheel is an approximation of the rear axle ratio.

Axle Shaft, Bearing and Seal

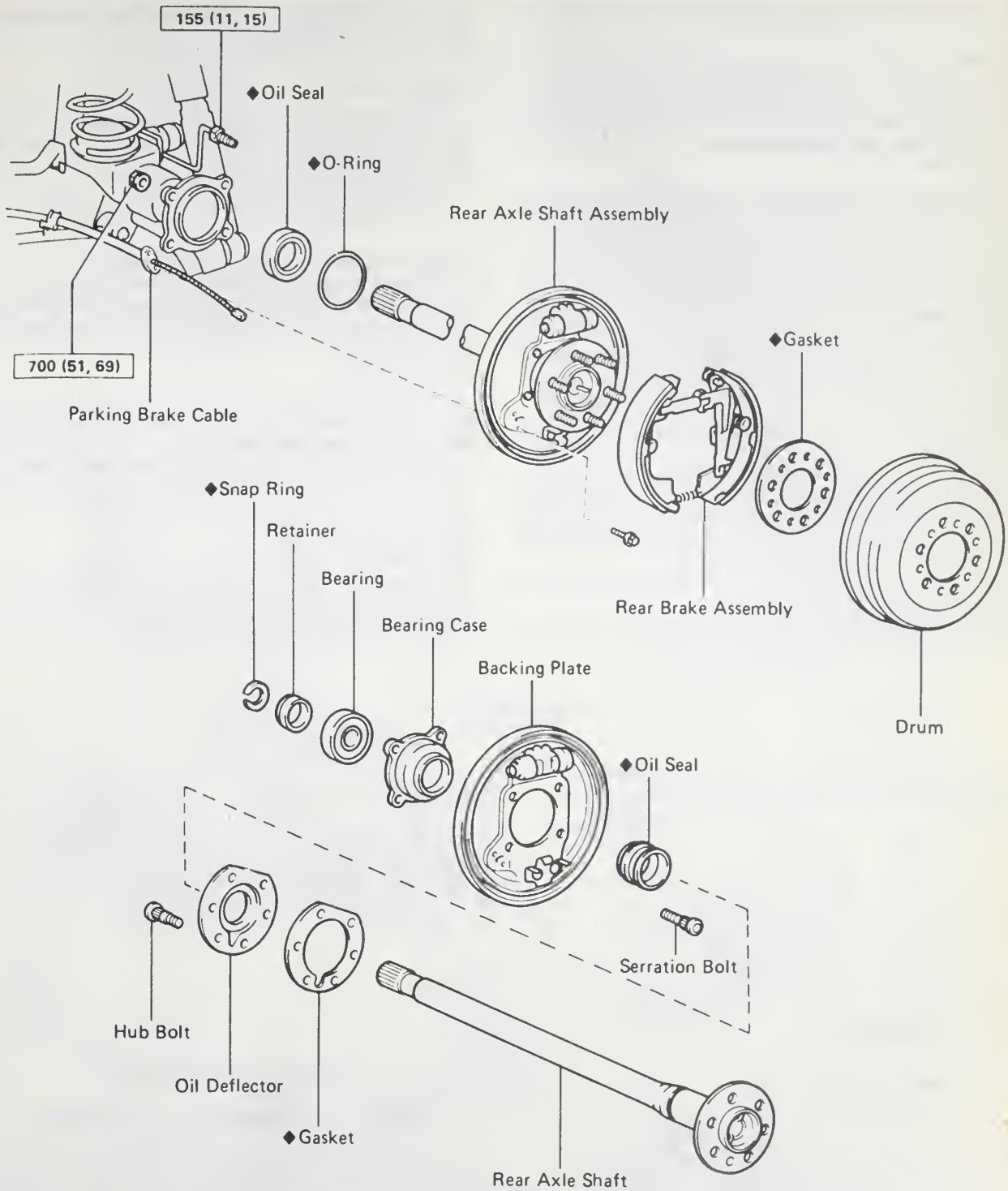
REMOVAL AND INSTALLATION

Pickups and 4Runner

1. Loosen the lug nuts on the wheel, then raise the truck and support it on jackstands.
2. Drain the axle housing.
3. Remove the lug nuts and remove the wheel.



Single tire rear axle — Trucks



kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

4Runner rear axle

7 DRIVE TRAIN

4. Remove the brake drum securing screw and remove the drum.

WARNING: Brake pads and shoes contain asbestos which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

5. Remove the brake springs and the retracting spring clamp bolt. Remove the lower springs and shoe strut. Remove the brake shoes, screws, and the parking brake lever. Disengage the parking brake cable from the lever and the backing plate.

6. Disconnect the brake line from the wheel cylinder, being careful not to damage the fitting. Plug the brake line.

7. Remove the four nuts retaining the brake backing plate to the axle housing.

8. Remove the snapping and then press the axle shaft out of the backing plate and slide the assembly out of the housing.

9. Remove the oil seal and press out the axle bearing.

To install:

10. Press a new bearing into the brake backing plate and replace the oil seal.

11. Install a new O-ring into the axle housing.

12. Install the axle shaft and brake backing plate assembly into the axle housing. Be careful not to damage the oil seal with the axle splines. Rotate the axle back and forth until the shaft splines mesh with the differential gear splines.

13. Install the brake backing plate nuts and tighten to 51 ft. lbs. (69 Nm). Install a new snapping.

14. Install the brake shoes and lever assembly. Connect the parking brake cable and the brake shoe springs.

15. After installing the brake drum, bleed the brakes and adjust the brake shoe clearance.

16. Refill the axle housing with lubricant.

Land Cruiser

1. Remove the wheel cover, if any, and loosen the wheel nuts.
2. Raise the rear axle housing with a jack and support the rear of the vehicle with jackstands.
3. Drain the oil from the differential.
4. Remove the wheel nuts and take off the wheels.
5. Remove the brake drum and related parts.

WARNING: Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

6. For 1991 vehicles, remove the load sensing proportioning valve bracket from the rear cover. Remove the cover from the back of the differential housing.

7. Remove the pin from the differential pinion shaft.

8. Withdraw the pinion shaft and its spacer from the case.

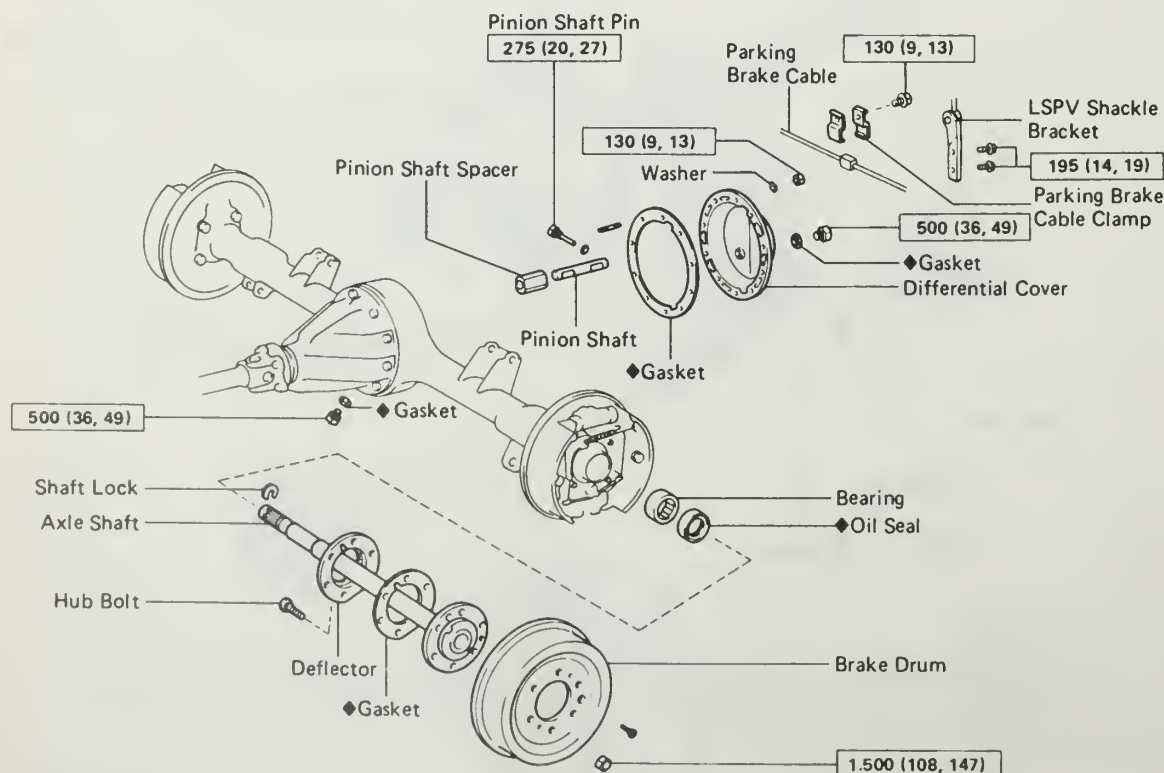
9. Press the rear shaft toward the differential, to aid in the removal of the axle shaft C-clip or axle shaft lock.

10. Remove the C-clip.

11. Withdraw the axle shaft from the housing.

12. Repeat the removal procedure for the opposite side.

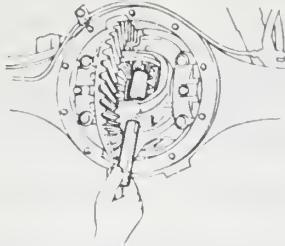
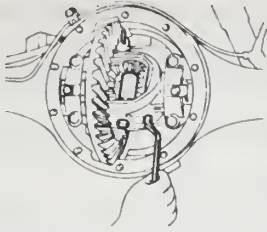
13. To remove oil seal and bearing, use a bearing puller and remove the axle bearing and oil seal together. To replace, use a metal tube to drive bearing and seal into seat.



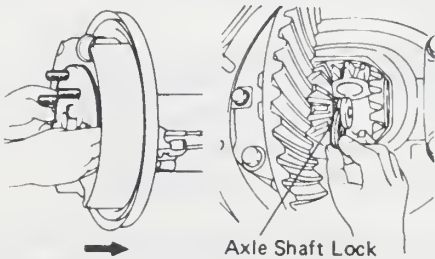
kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

Land Cruiser rear axle shaft components



Removing the pinion shaft and spacer. Be ready for the pinion gear and washer to come out, too



Push In on the axle and remove the C-clip

NOTE: Do not mix the parts of the left and the right axle shaft assemblies.

14. After installing the axle shaft, C-lock, spacer and pinion shaft, measure the clearance between the axle shaft and the pinion shaft spacer with a feeler gauge. The clearance should be no more than 5mm. If the clearance is not within specifications, use one of the following spacers to adjust it.

- 29.00mm
- 29.39mm
- 29.80mm
- 30.20mm
- 30.60mm

15. Install the axle lubricant.

Differential Carrier

REMOVAL AND INSTALLATION

1. Raise the rear of the truck and support it on safety stands.
2. Remove the drain plug and drain the differential oil.
3. Remove the rear axle shafts.
4. Disconnect the driveshaft at the differential. On vehicles with anti-lock brakes, remove the rear speed sensor from the differential housing and disconnect the wiring harness clip from the housing.

5. Remove the mounting bolts and lift out the differential carrier assembly.

6. Install a new gasket and position the carrier assembly into the axle housing. Tighten the mounting bolts to 18 ft. lbs. (25 Nm) on the Pickup and 4Runner and 34 ft. lbs. (47 Nm) on the Land Cruiser.

7. Connect the driveshaft to the companion flange on the differential. Install the rear speed sensor if it was removed; install the wire harness clips.

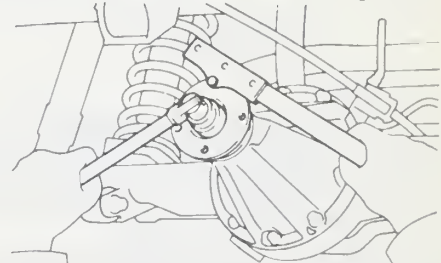
8. Install the rear axle shafts.

9. Lower the truck and fill the differential with gear oil. Drive the truck and check for any leaks.

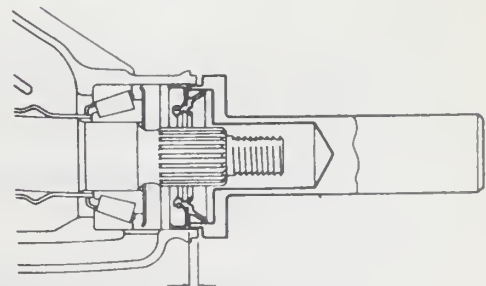
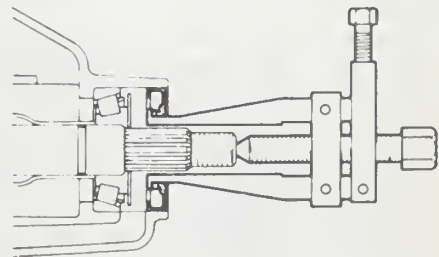
Pinion Seal

REMOVAL AND INSTALLATION

1. Elevate and safely support the vehicle.
2. Matchmark the flanges on the driveshaft and pinion. Disconnect the driveshaft from the differential.
3. Use a hammer and small chisel to loosen the staking on the companion flange bolt. Attach a counterholding tool to the companion flange and remove the nut. Use the proper threaded extractor to remove the companion flange.
4. Use an extractor to remove the oil seal and oil slinger from the housing.
5. Make certain the new seal faces in the correct direction. Install the new seal with a driver or seal installation tool of the correct diameter. Drive the new seal in until it is recessed 1.0mm (0.039 in) in the housing.
6. Coat the inner lip of the seal with multi-purpose grease. Install the companion flange (and washer, if removed). Apply a light coat of oil to the threads of a NEW companion flange nut.



A counterholding tool must be used or the companion flange nut cannot be loosened or tightened



Drive in Depth

Use correct puller and driver to deal with the seal. Other tools will damage either the seal or the housing

7 DRIVE TRAIN

7. Set up the counterholding tool and install the companion flange nut. For trucks and 4Runners, tighten it to 145 ft. lbs. (196 Nm). On Land Cruisers, tighten the nut to 181 ft. lbs. (245 Nm).

8. Check the drive pinion preload. Use a torque wrench to measure the backlash between the drive pinion and the ring gear. For trucks and 4Runners, correct torque is 7.8–11.3 inch lbs for 2-pinion differentials and 4.3–6.9 inch lbs. for 4-pinion units. Land Cruisers should test between 6.1 and 8.7 inch lbs.

9. If the preload is greater than specified, the bearing space must be removed and replaced inside the pinion housing. Do NOT back off the companion flange nut to relieve the pressure.

If the preload is less than specified (the usual case), retighten the companion flange nut in increments of 9 ft. lbs. (13 Nm) until the correct spec is reached. Maximum allowable torque on the nut under any condition is 325 ft. lbs. (441 Nm) for Land Cruiser and 253 ft. lbs. (343 Nm) for trucks and 4Runner. Take great care not to exceed either the preload limit or the maximum torque on the nut.

10. Stake the drive pinion nut.

11. Connect the rear propeller shaft, aligning the matchmarks.

12. Lower the vehicle to the ground; inspect the fluid level in the axle.

Differential OVERHAUL

Trucks and 4Runner

1. Remove the differential carrier assembly.

2. Use a hammer and small chisel to loosen the staking on the companion flange bolt. Attach a counterholding tool to the companion flange and remove the nut. Use the proper threaded extractor to remove the companion flange.

3. Remove the oil seal and oil slinger.

4. Use an extractor to remove the front bearing from the drive pinion and remove the bearing spacer.

5. Place matchmarks on the bearing cap and differential carrier. Remove the 2 adjusting nut locks, the 2 bearing caps and the adjusting nuts.

6. Remove the outer bearing races and remove the differential case from the carrier. Label or tag every part for reassembly; left side and right side parts are NOT interchangeable.

7. Remove the drive pinion from the differential carrier.

8. Inspect the rear bearing on the pinion. Use a press to remove the bearing if necessary; if the bearing is replaced, the washer may be reused. Note that the washer installs with the chamfered side facing the pinion gear.

9. The bearing outer races may be driven from the case; install the new ones with a press and driver.

10. Use a bearing puller to remove the side bearings from the differential case.

11. Place matchmarks on the ring gear and differential case. Unstake the locking plates and remove the ring gear bolts and lock plates. Tap the ring gear to separate it from the case.

12. On 2-pinion differential cases, use a hammer and punch to drive out the straight pin. Remove the pinion shaft, the 2 side gears and the thrust washer.

13. For 4-pinion units, matchmark the left and right cases. Remove the 8 bolts and separate the halves. Remove the side gears, spider, 4 pinion gears and all the thrust washers.

14. For 2-pinion differentials:

a. Install the side gears into the case after inspection. Select thrust washers which will allow back lash to fall within the range 0.05–0.20 mm. If possible, select washers of the same thickness for both sides.

b. Install the washers and side gears in the differential case.

c. Check the side gear backlash while holding one pinion gear towards the case.

d. If backlash is not within specification, replace the thrust washer. Standard washer thicknesses are: 1.6, 1.7 and 1.8 mm.

e. Install the straight pin. Stake the pin and differential case.

15. For 4-pinion differentials:

a. Install the thrust washer to the side gear after inspection and install the side gear to the right case half.

b. Install the 4 pinion gears and thrust washers to the spider.

c. Install the pinion gear and spider to the right case half.

d. Hold the side gear and measure the backlash; correct backlash is 0.05–0.20 mm.

e. If the backlash is not correct, install a thrust washer of a different dimension, making sure equal sized washers are used on each side. Standard washer thicknesses are: 0.9, 1.0, 1.1, 1.2 and 1.3 mm.

f. Install the side gear and correct thrust washers to the right case half.

g. Install the pinion gears and spider to the right case. Install the side gear and thrust washer to the left case half.

h. Apply gear oil to the parts. Align the matchmarks on the case halves; install the bolts and tighten them evenly to 35 ft. lbs. (47 Nm).

Assembly

16. Clean the contact surface of the differential case. Heat the ring gear to 212°F (100°C) but not above 230°F (110°C).

CAUTION

Use extreme care when dealing with boiling water or fluid. Have tongs and heavy gloves available before beginning the job.

17. Remove the heated ring gear and quickly install it on the differential case. Align the matchmarks, coat the set bolts with gear oil and temporarily install the bolts and lock plates. Walk away from the unit and allow it to cool naturally for at least an hour.

18. When the unit is cooled sufficiently, tighten the bolts to 71 ft. lbs. (97 Nm). Stake the lock plates to the bolts.

19. Use a press to install the side bearings on the differential case.

20. Install the differential case onto the carrier and tighten the adjusting nut just to the point at which there is no play in the bearings.

21. Check the ring gear runout; maximum allowable is 0.10mm.

22. Install the drive pinion and front bearing; this is a temporary set-up without the seal and spacer. Install the companion flange on the pinion shaft.

23. Adjust the drive pinion preload by tightening the companion flange nut. Tighten a little at a time. Use a torque wrench to check preload:

- New bearing, 4-pinion: 8.7–13.9 inch lbs. (1.0–1.6 Nm)
- New bearing, 2-pinion: 16.5–22.6 inch lbs. (1.9–2.5 Nm).
- Old bearing reused, 4-pinion: 4.3–6.9 inch lbs. (0.5–0.8 Nm)
- Old bearing reused, 2-pinion: 7.8–11.3 inch lbs. (0.9–1.3 Nm)

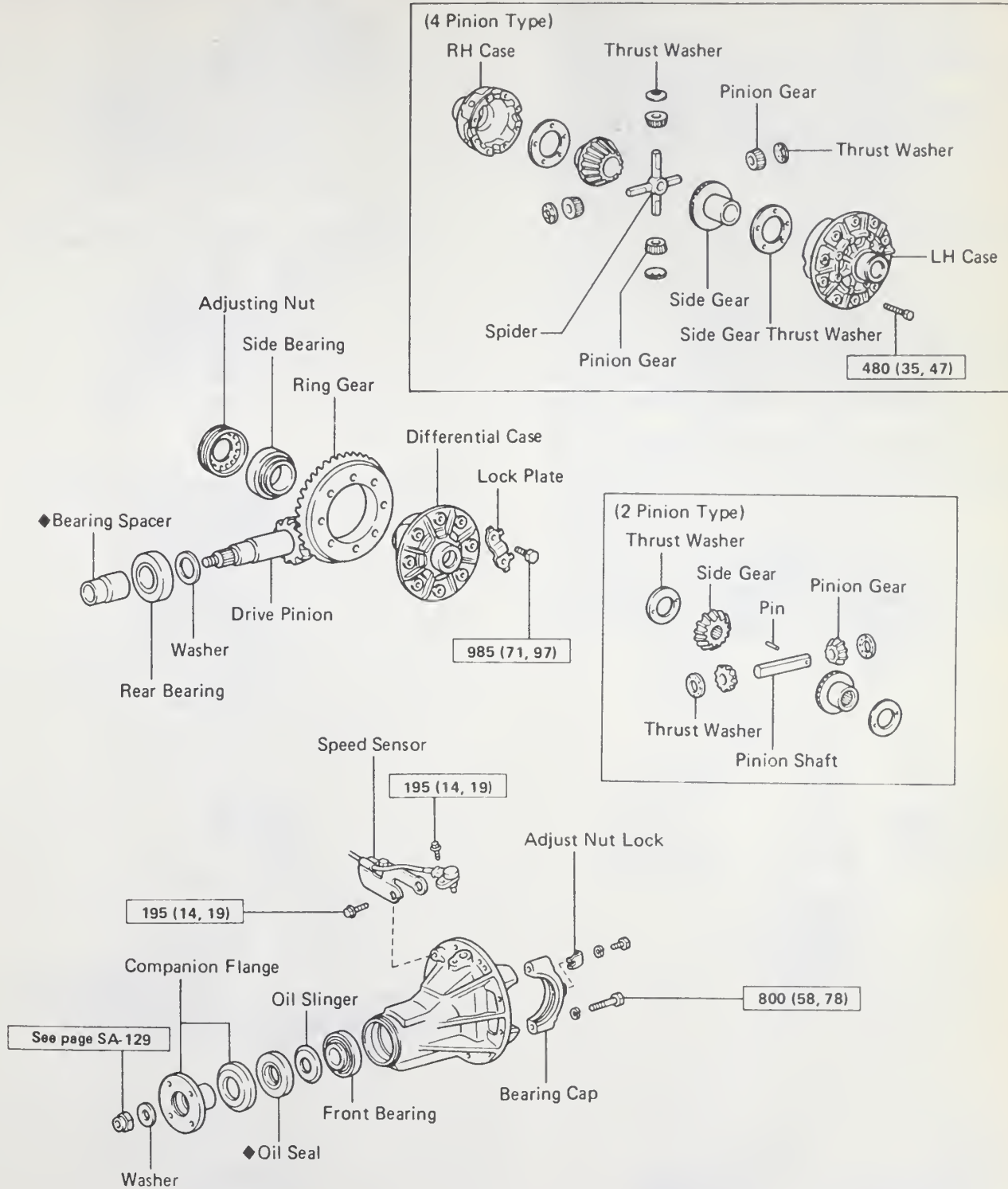
24. Place the outer bearing races on the proper bearings; install the case in the carrier.

25. Install the adjusting nuts on the carrier.

26. Install the bearing caps, aligning the matchmarks made at removal. Screw the bearing cap bolts two or three turns by hand and press down the bearing cap. If the bearing cap does not fit tightly on the carrier, the adjusting bolts are mis-threaded.

27. Tighten the four bearing cap bolts to 58 ft. lbs. (78 Nm), then loosen them to where they can be turned by the fingers. Retighten each bolt with the fingers only as tight as possible.

28. Use tool 09504-00011 or its equivalent to tighten the ad-

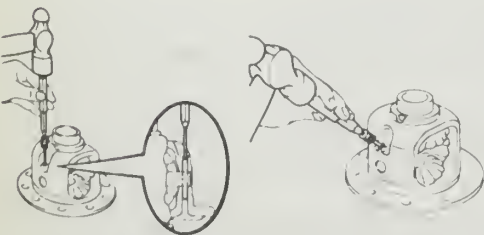
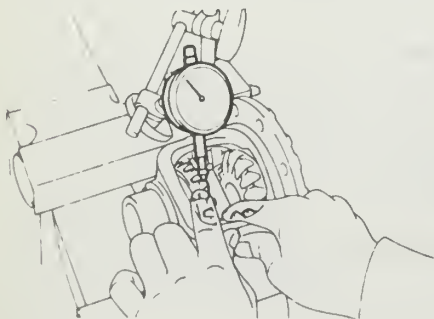
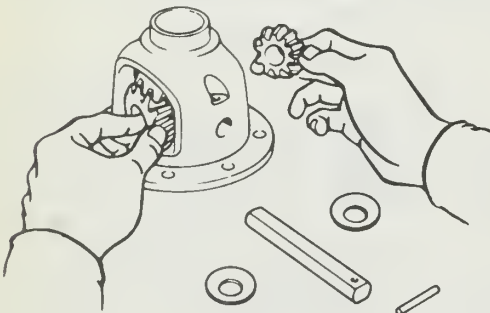
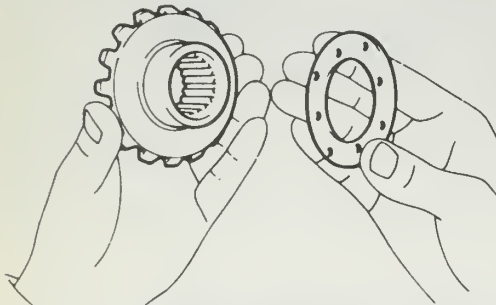
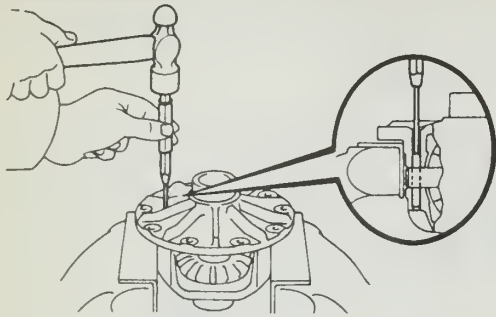


kg-cm (ft-lb, N·m) : Specified torque

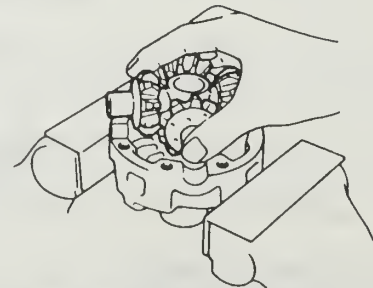
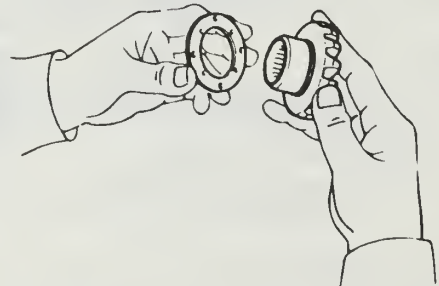
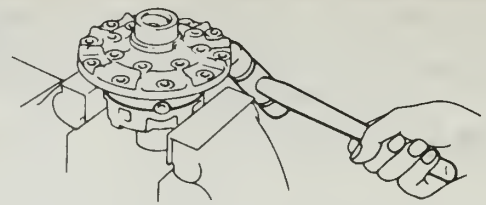
◆ Non-reusable part

Differential components – Truck and 4Runner

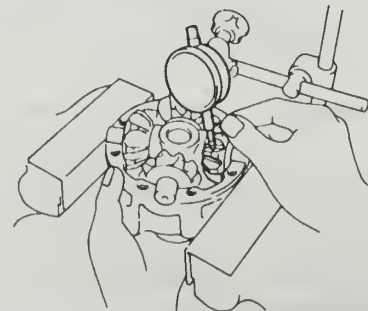
7 DRIVE TRAIN



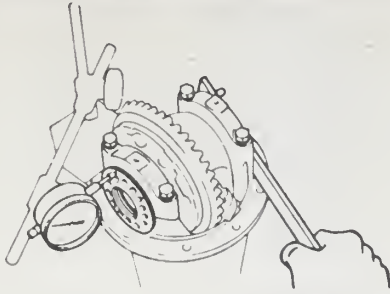
Disassembly and inspection of 2-pinion differential case



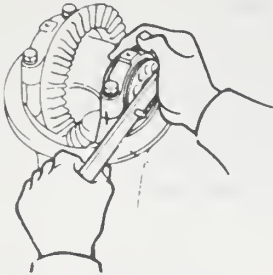
Disassembly and inspection of the 4-pinion differential case



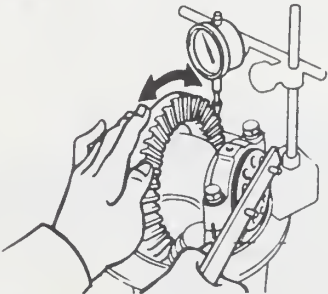
Measuring backlash on the 4-pinion differential



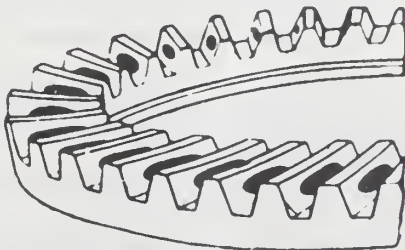
Adjust the side bearing for zero preload



tighten the adjusting nut 1 or 1½ notches



Check the ring gear backlash



Proper Contact

justing nut on the ring gear until the ring gear has a backlash of about 0.2mm.

29. Turn the ring gear and use the tool to fully tighten the adjusting nut on the pinion side. After the bearings are settled, loosen the adjusting nut on the pinion side.

30. Mount a dial indicator on top of the adjusting nut on the ring gear side. Adjust the side bearing for zero preload by tightening the other adjusting nut until the pointer on the indicator begins to move.

31. Tighten the adjusting nut 1-1½ notches from the zero preload position.

32. Use the dial indicator to adjust the ring gear backlash to 0.13-0.18 mm. Backlash is adjusted by turning the left and right adjusting nuts equal amounts.

33. Tighten the bearing cap bolts to 58 ft. lbs. (78 Nm) and recheck the ring gear backlash.

34. Inspect the tooth contact between the ring gear and drive pinion gear. Coat several consecutive teeth at several positions on the ring gear with a gear paint such as red lead or engineers' blue. Hold the companion flange firmly and rotate the ring gear in both directions. Examine the tooth pattern left in the gear paint.

35. If the pattern reveals heel or face contact, select a pinion shim which will bring the drive pinion closer to the ring gear. If the pattern reveals toe or flank contact, a shim must be selected to shift the pinion away from the ring gear. The correct contact pattern is centered on the shoulder of each tooth and is neither too high nor too low on the tooth.

36. Remove the companion flange and the front bearing. Remove pinion shaft and replace the washer as necessary.

37. Install a new bearing spacer and the front bearing on the shaft. Install the oil slinger and the oil seal. Drive the seal in only to a depth of 1.0mm inside the case.

Heel Contact



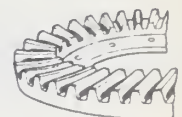
Face Contact



Toe Contact



Flank Contact



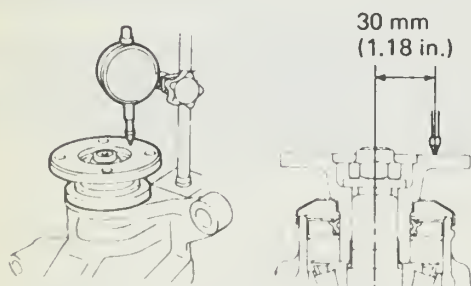
Ring and pinion teeth patterns

7 DRIVE TRAIN

mm (in.)

1.70	(0.0669)	2.03	(0.0799)
1.73	(0.0681)	2.06	(0.0811)
1.76	(0.0693)	2.09	(0.0823)
1.79	(0.0705)	2.12	(0.0835)
1.82	(0.0717)	2.15	(0.0846)
1.85	(0.0728)	2.18	(0.0858)
1.88	(0.0740)	2.21	(0.0870)
1.91	(0.0752)	2.24	(0.0882)
1.94	(0.0764)	2.27	(0.0894)
1.97	(0.0776)	2.30	(0.0906)
2.00	(0.0787)	2.33	(0.0917)

Select adjusting washers from this chart for truck and 4Runner



After assembly, perform a final check of the companion flange runout

38. Install the companion flange. Coat the threads of a NEW nut with multi-purpose grease and tighten the nut to 145 ft. lbs. (196 Nm).

39. Adjust the drive pinion preload by tightening the companion flange nut. Tighten a little at a time in increments of 9 ft. lbs. (13 Nm). Do not exceed 253 ft. lbs. (343 Nm) on the nut. If this maximum torque is exceeded, replace the bearing spacer and repeat the preload check; do NOT back off the pinion nut to reduce preload.

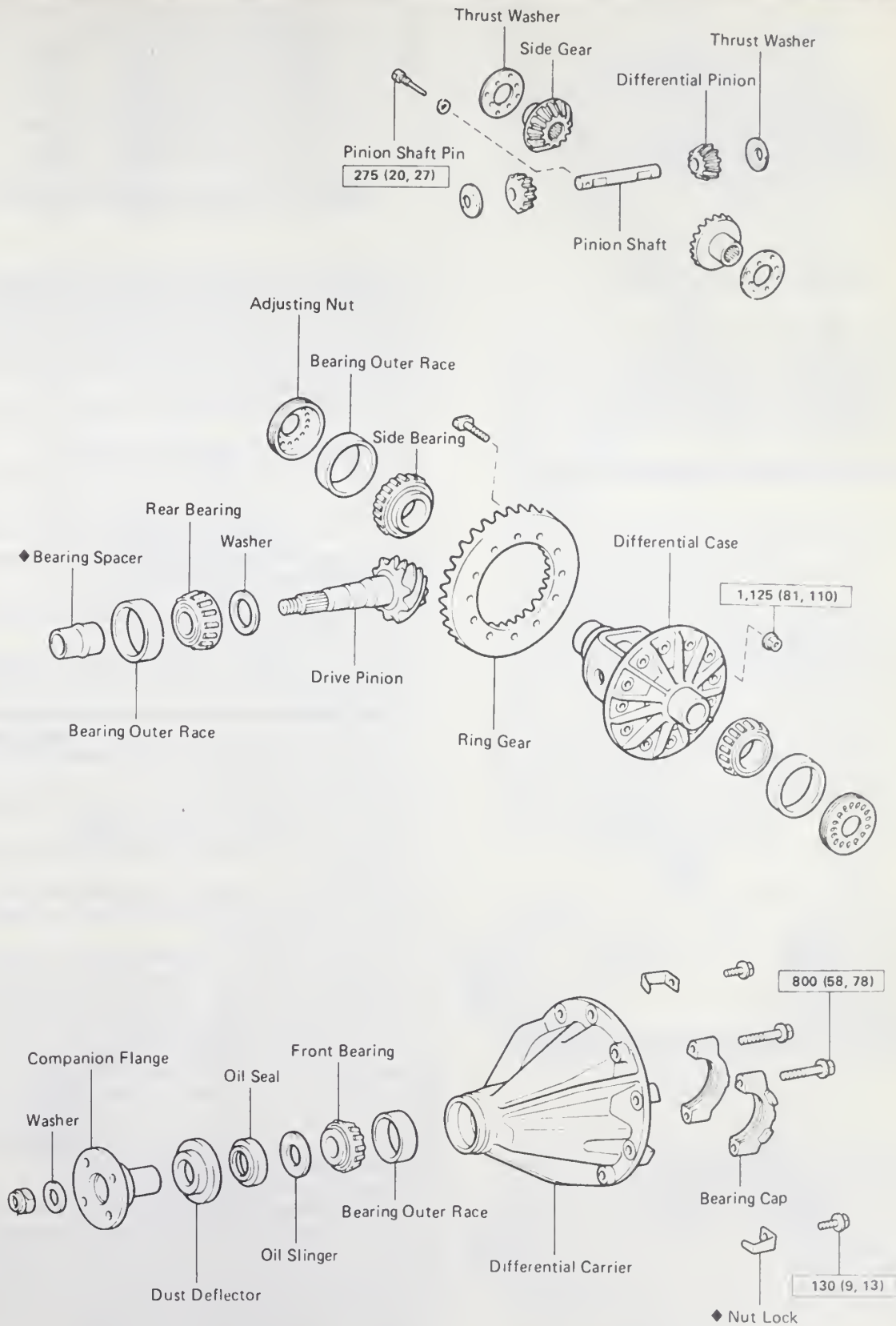
- New bearing, 4-pinion: 8.7–13.9 inch lbs. (1.0–1.6 Nm)
- New bearing, 2-pinion: 16.5–22.6 inch lbs. (1.9–2.5 Nm)
- Old bearing reused, 4-pinion: 4.3–6.9 inch lbs. (0.5–0.8 Nm)
- Old bearing reused, 2-pinion: 7.8–11.3 inch lbs. (0.9–1.3 Nm)

40. Use a dial indicator to measure the vertical runout of the companion flange; maximum allowable is 0.10 mm or 0.0039 in.

41. Stake the drive pinion nut. Install the adjusting nut locks on the adjusting nuts. Install the lock on the bearing caps and tighten the bolts to 9 ft. lbs. (13 Nm).

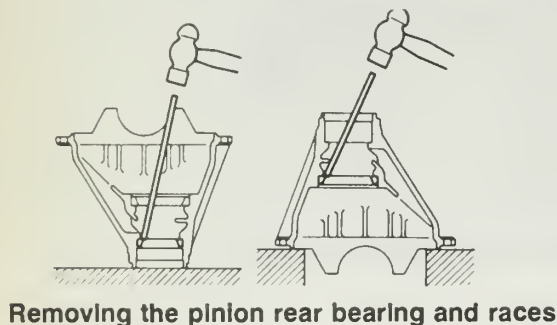
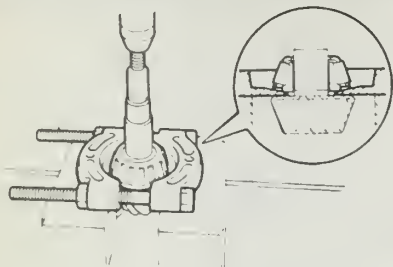
Land Cruiser

1. Remove the differential carrier assembly.
2. Use a hammer and small chisel to loosen the staking on the companion flange bolt. Attach a counterholding tool to the companion flange and remove the nut. Use the proper threaded extractor to remove the companion flange.
3. Remove the oil seal and oil slinger.
4. Use an extractor to remove the front bearing from the drive pinion and remove the bearing spacer.
5. Place matchmarks on the bearing cap and differential carrier. Remove the 2 adjusting nut locks, the 2 bearing caps and the adjusting nuts.
6. Remove the outer bearing races and remove the differential case from the carrier. Label or tag every part for reassembly; left side and right side parts are NOT interchangeable.
7. Remove the drive pinion from the differential carrier.
8. Inspect the rear bearing on the pinion. Use a press to remove the bearing if necessary; if the bearing is replaced, the washer may be reused. Note that the washer installs with the chamfered side facing the pinion gear.
9. The bearing outer races may be driven from the case; install the new ones with a press and driver.
10. Make matchmarks on the ring gear and differential case. Remove the 12 nuts and bolts. Tap on the ring gear to remove it from the case.
11. Remove the side bearings from the differential case using the correct puller to extract the bearing.
12. Remove the pinion shaft pin. Remove the pinion shaft, two differential pinions, thrust washers, side gears and side gear thrust washers.
13. Remove the dust deflector from the companion flange using a press and driver. Install a new dust deflector.
14. Install the thrust washers and side gears into the differential case. Align the hold for the pinion shaft with the case hole.

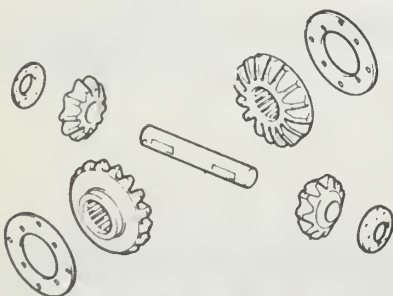
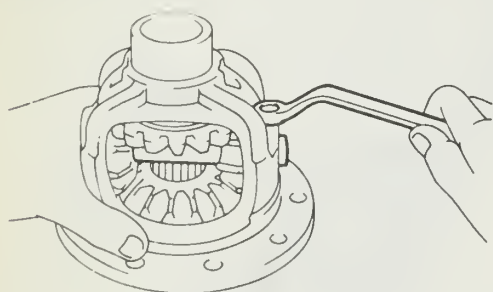


Land Cruiser differential components

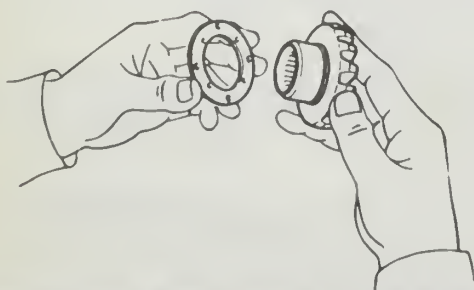
7 DRIVE TRAIN



Removing the pinion rear bearing and races



Disassembly of the differential case and component parts



Install the correct thrust washer on the side gear

Thrust washer thickness	mm (in.)
1.55 — 1.65 (0.0610 — 0.0650)	
1.70 — 1.80 (0.0669 — 0.0709)	
1.85 — 1.95 (0.0728 — 0.0768)	
2.00 — 2.10 (0.0787 — 0.0827)	

Select the thrust washer from this chart

15. Measure the side gear backlash while holding one pinion gear toward the case. Correct backlash is 0.02–0.20mm. If the backlash is not within specification, select thrust washers which will bring the backlash into compliance. Select equal sized washers for each side. Remove the side gears, replace the washers and repeat the backlash procedure.

16. Install the pinion shaft pin and tighten it to 20 ft. lbs. (27 Nm).

17. Install the side bearings using a press.

18. Clean the contact surfaces of the differential case and ring gear.

19. Heat the ring gear in water to brought to the boiling point.

CAUTION

Use extreme care when dealing with boiling water. Have tongs and heavy gloves available before beginning the job.

20. Once heated, remove the ring gear and suspend it, allowing water to drip off and/or evaporate.

21. When completely dry (but still hot!), quickly align the matchmarks made at removal and install the ring gear to the differential case.

22. Temporarily install the 12 nuts and bolts in the ring gear and differential case. Install the bolts so that the tapered part of the bolt is on the ring gear side. The nuts should only be brought down finger tight; no more.

Walk away from the job, allowing it to cool for at least an hour.

23. When the ring gear has cooled close to room temperature, tighten the 12 nuts to 81 ft. lbs. (110 Nm).

24. Use a press to install the pinion bearing outer races if they were removed.

25. Install the plate washer on the pinion shaft with the chamfered end facing the pinion gear. Use a press to install the rear bearing to the drive pinion.

26. Temporarily install the pinion and front bearing. Install the oil slinger. Install the companion flange and plate washer.

27. Adjust the drive pinion preload by tightening the flange nut. The nut and its threads should be lightly coated with gear oil. Correct preload if a new bearing has been installed is 11.3–17.4 inch lbs. (1.3–2.0 Nm). If the bearing has been reused, preload should be 6.1–8.7 inch lbs (0.7–1.0 Nm). Tighten the nut carefully, a little at a time, without exceeding the preload spec.

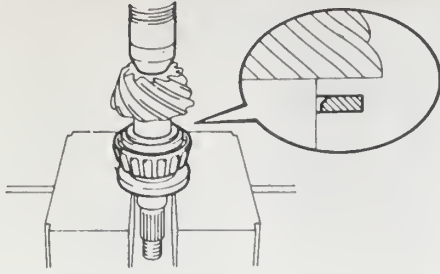
28. Place the outer bearing races onto their respective bearings, making certain that left and right are not interchanged. Install the carrier into the case.

29. Install the adjusting nuts on the carrier.

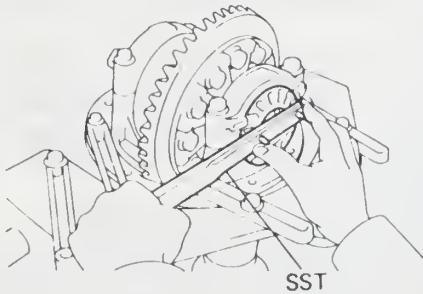
30. Install the bearing caps. Align the matchmarks on cap and carrier. Turn the bolts down 2 or 3 turns and press the bearing cap down by hand. If the bearing cap does not fit tightly on the carrier, the adjusting nuts are not threaded properly.

31. Tighten the 4 bearing cap bolts to 58 ft. lbs. (78 Nm), then loosen them to the point at which they can be turned by hand. Use fingers to tighten the bolts down snug.

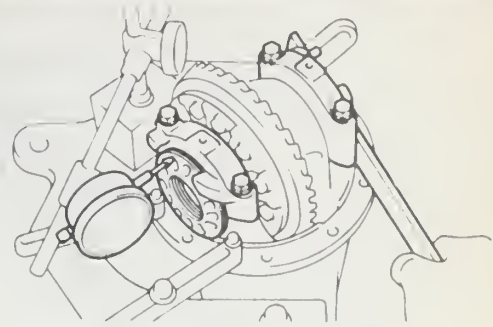
32. Using tool 09504-00011 or its equivalent, tighten the adjusting nut on the ring gear side until the ring gear has a backlash of about 0.2mm.



Correct placement of the washer when installing the rear bearing on the pinion shaft



A special tool is required when tightening the adjusting nuts



Adjusting for zero preload

33. Turn the ring gear and use the tool to fully tighten the adjusting nut on the pinion side. After the bearings are settled, loosen the adjusting nut on the pinion side.

34. Mount a dial indicator on top of the adjusting nut on the ring gear side. Adjust the side bearing for zero preload by tightening the other adjusting nut until the pointer on the indicator begins to move.

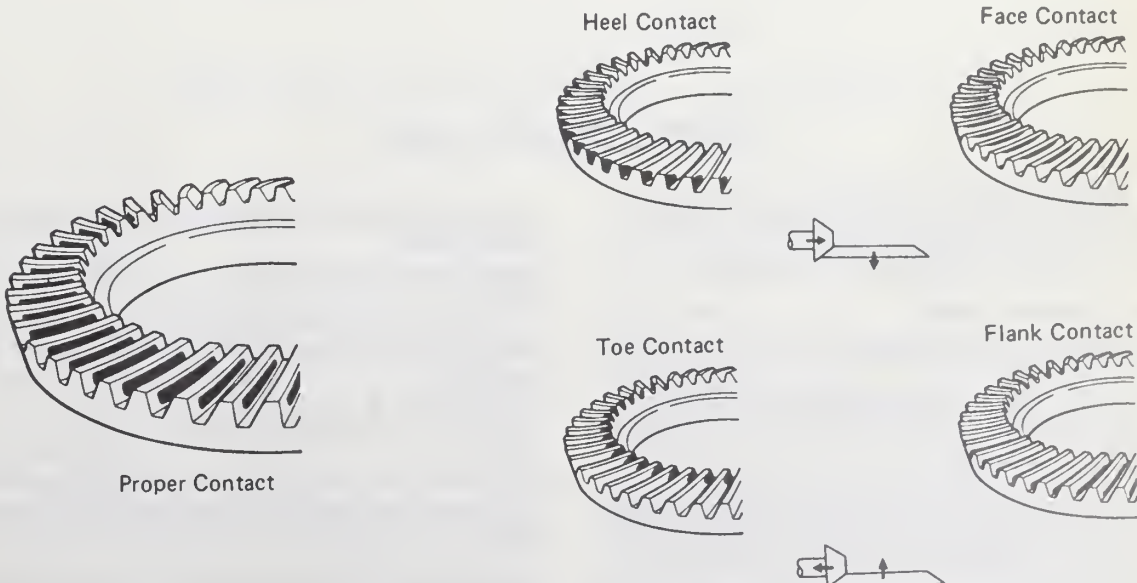
35. Tighten the adjusting nut 1-1½ notches from the zero preload position.

36. Use the dial indicator to adjust the ring gear backlash to 0.15-0.20mm. Backlash is adjusted by turning the left and right adjusting nuts equal amounts.

37. Tighten the bearing cap bolts to 58 ft. lbs. (78 Nm) and recheck the ring gear backlash.

38. Inspect the tooth contact between the ring gear and drive pinion gear. Coat several consecutive teeth at several positions on the ring gear with a gear paint such as red lead or engineers' blue. Hold the companion flange firmly and rotate the ring gear in both directions. Examine the tooth pattern left in the gear paint.

39. If the pattern reveals heel or face contact, select a pinion shim which will bring the drive pinion closer to the ring gear. If the pattern reveals toe or flank contact, a shim must be selected to shift the pinion away from the ring gear. The correct contact pattern is centered on the shoulder of each tooth and is neither too high nor too low on the tooth.

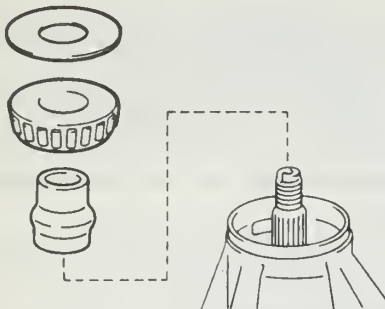


Ring and pinion teeth patterns

7 DRIVE TRAIN

Washer thickness		mm (in.)
1.05	(0.0413)	1.35 (0.0531)
1.10	(0.0433)	1.40 (0.0551)
1.15	(0.0453)	1.45 (0.0571)
1.20	(0.0472)	1.50 (0.0591)
1.25	(0.0492)	1.55 (0.0610)
1.30	(0.0512)	

Use this chart to select Land Cruiser pinion washers



Install the new bearing spacer, bearing and oil slinger

on the adjusting nuts. Install the lock on the bearing caps and tighten the bolts to 9 ft. lbs. (13 Nm).

40. Remove the companion flange and the front bearing. Remove the pinion shaft and replace the washer as necessary.

41. Install a new bearing spacer and the front bearing on the shaft. Install the oil slinger and the oil seal. Drive the seal in only to a depth of 1.0mm inside the case.

42. Install the companion flange. Coat the threads of a NEW nut with multi-purpose grease and tighten the nut to 181 ft. lbs. (245 Nm).

43. Adjust the drive pinion preload by tightening the companion flange nut. Tighten a little at a time in increments of 9 ft. lbs. (13 Nm). Do not exceed 253 ft. lbs. (343 Nm) on the nut. If this maximum torque is exceeded, replace the bearing spacer and repeat the preload check; do NOT back off the pinion nut to reduce preload.

New bearing: 11.3–17.4 inch lbs (1.3–2.0 Nm)

Old bearing: 6.1–8.7 inch lbs. (0.7–1.0 Nm)

44. Use a dial indicator to measure the vertical runout of the companion flange; maximum allowable is 0.10 mm or 0.0039 in.

41. Stake the drive pinion nut. Install the adjusting nut locks

FRONT DRIVE AXLE

Axle Shaft, Hub, Bearing and Seal

REMOVAL AND INSTALLATION

Pickup and 4Runner—4WD

1. Raise the front of the vehicle and support on safety stands. Remove the wheel.

2. Remove the free-wheeling or automatic locking hub.

3. Disconnect and plug the brake line at the disc and wire it out of the way.

4. Remove the brake caliper.

5. Pop off the axle nut lock washer and remove the nut and washer. Remove the adjusting nut. Remove the axle hub/brake disc as an assembly along with the outer wheel bearing.

6. Pry out the oil seal and remove the inner bearing from the hub.

7. Loosen the 6 axle shaft-to-differential housing nuts.

NOTE: This may require that a friend steps on the brake pedal.

8. Remove the snapping and spacer from the end of the axle shaft.

9. Separate the inboard axle shaft flange from the side gear shaft and then remove the shaft down and through the steering knuckle.

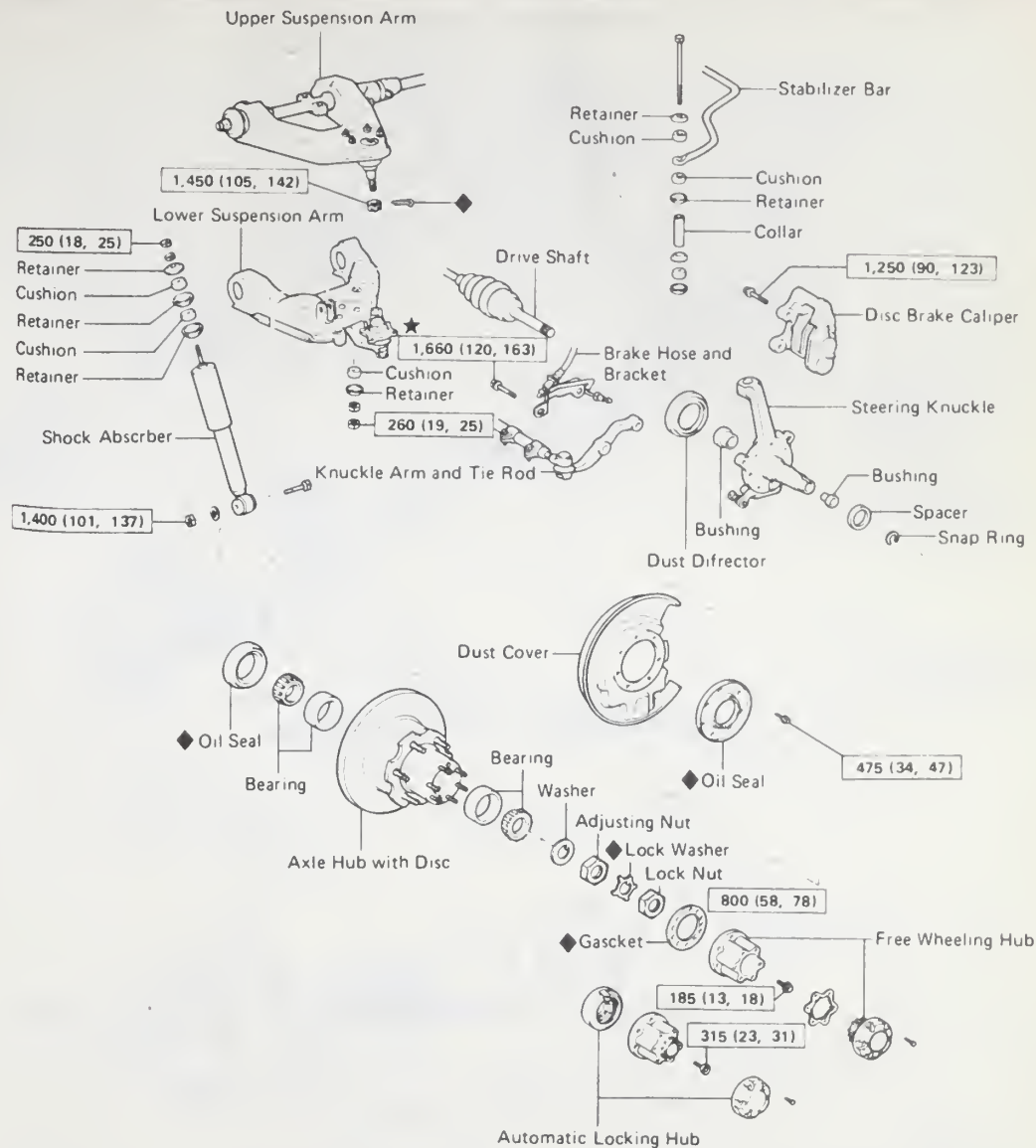
To install:

10. Coat the outboard end of the axle shaft with lithium grease.

11. Insert the outboard end of the shaft into the steering knuckle and then install it to the differential. Hand tighten the bolts.

WARNING: Do not damage the axle shaft boots.

12. Install the spacer and a new snapping.



Exploded view of front hub and bearing – Truck and 4Runner

13. Depress the brake pedal and tighten the inner mounting nuts to 61 ft. lbs. (83 Nm).

14. Pack the inner axle bearing with grease and press it into the hub. Coat a new oil seal with grease and press it into the hub.

15. Position the axle hub/brake disc assembly on the steering knuckle and press in the outer bearing.

16. Tighten the bearing adjusting nut to 43 ft. lbs. (59 Nm) and spin the hub a few times. Loosen the nut and then Retighten it to 18 ft. lbs. (25 Nm).

17. Use a tension gauge and check that the bearing preload is 6.4-12.6 lbs.

18. Install a new locknut and washer and tighten to 58 ft. lbs. (78 Nm). Check that the bearing has no axial play. Secure the locknut by bending one of the washer teeth inward and another outward.

19. Install the free-wheeling or automatic hub.

20. Install the brake caliper and line. Install the wheel, lower the vehicle and bleed the brakes. Road test the truck.

Land Cruiser

1. Raise and support the vehicle securely and remove the wheel assembly.

2. Plug the brake master cylinder reservoir to prevent brake fluid leakage from the disconnected brake flexible hose.

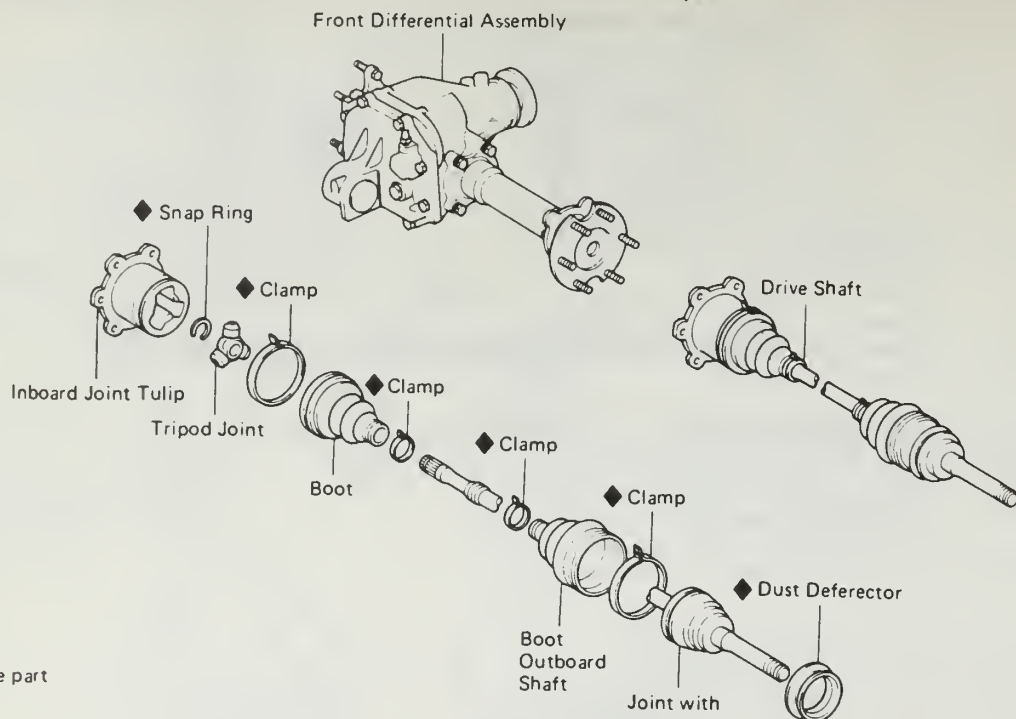
3. Remove the outer axle shaft flange cap, and then remove the shaft snapping on the outer shaft.

4. Remove the bolts retaining the outer axle shaft flange onto the front axle hub, and then, screw service bolts into the shaft flange alternately, and remove the shaft flange with its gasket.

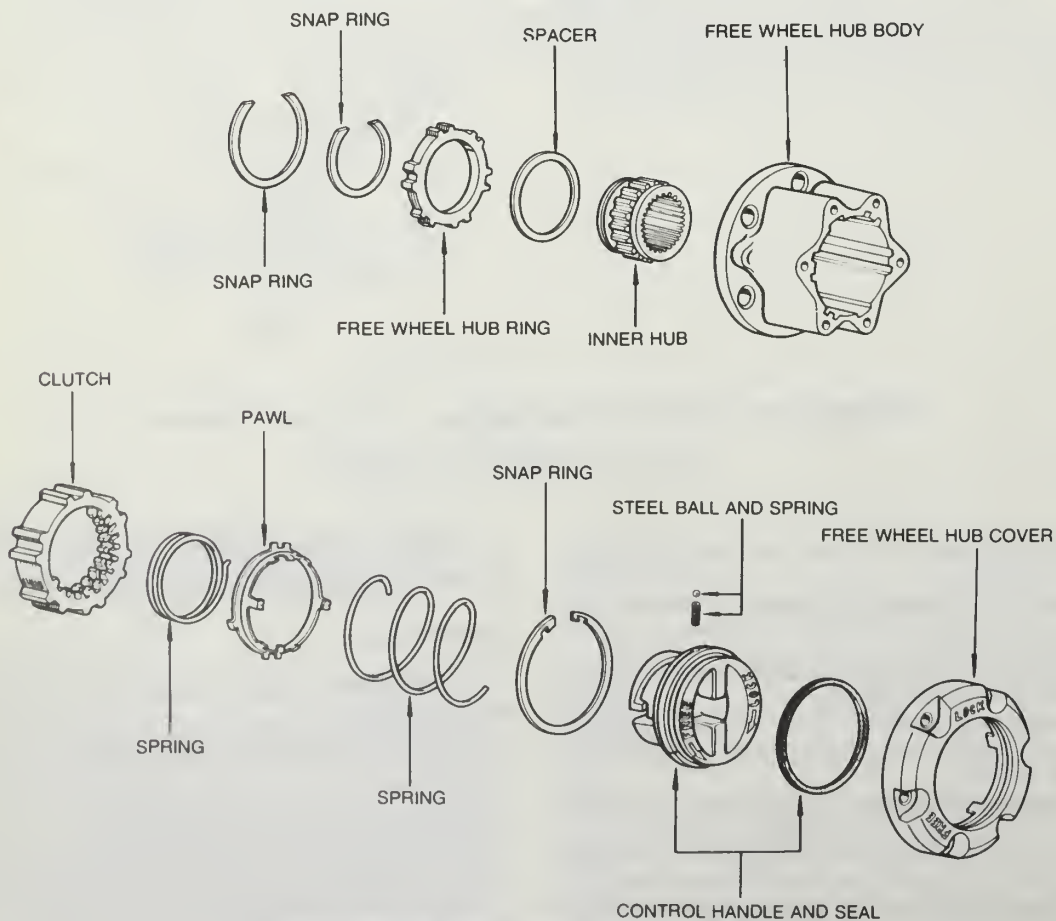
5. Remove the brake drum set screws and remove the brake drum. If equipped with disc brakes, remove the caliper and disc.

6. Straighten the lockwasher, and remove the front wheel

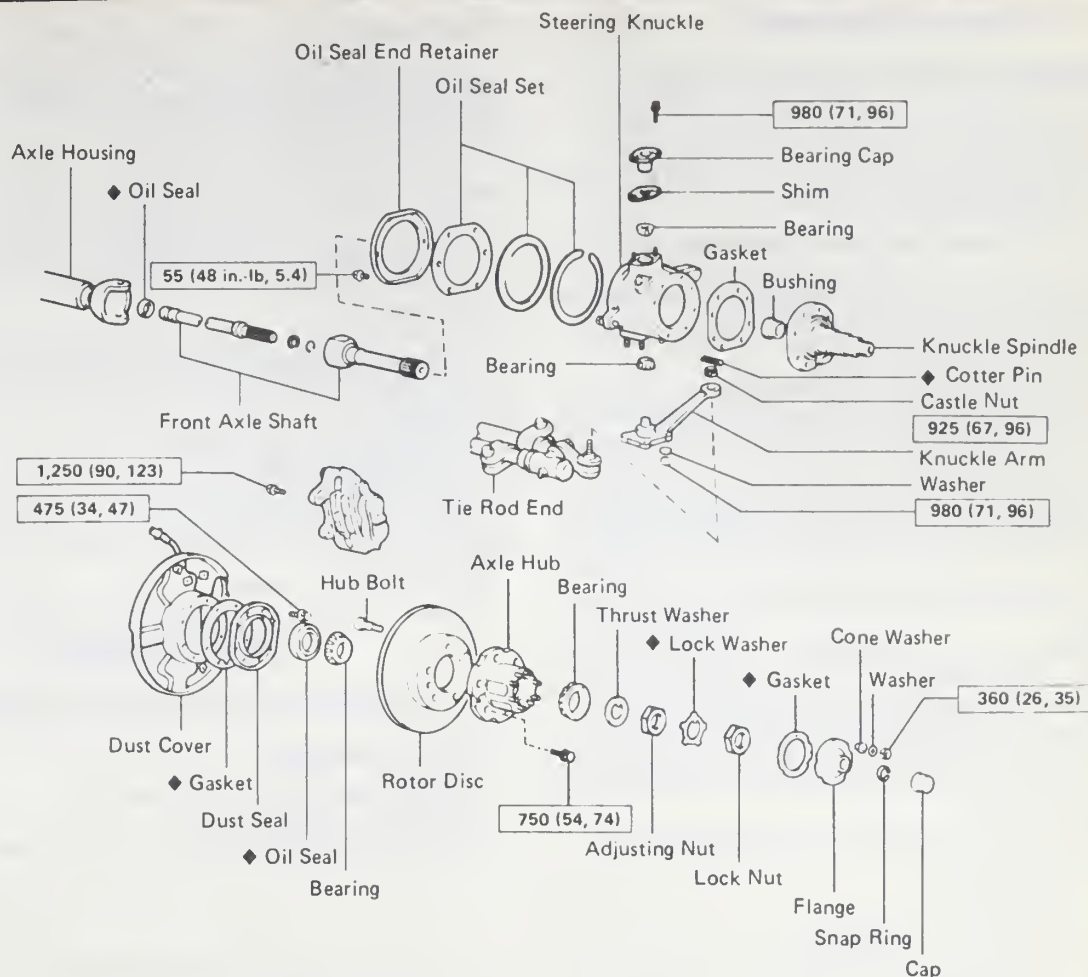
7 DRIVE TRAIN



Front axle shaft — Truck and 4Runner



Exploded view of free wheeling hub



Land Cruiser front hub, axle and steering knuckle components

bearing adjusting nuts with front wheel adjusting nut wrench or similar tool.

7. Remove the front axle hub together with its claw washer, bearings, and oil seal.

8. Remove the clip and disconnect the brake flexible hose from the brake tube.

9. Cut and remove the lock wire and remove the bolts retaining the brake backing plate onto the steering knuckle. Remove the brake backing plate together with the brake shoes, tension spring, and the wheel cylinder still assembled to the backing plate.

10. Tap the steering knuckle spindle lightly with a soft mallet, and remove the spindle with its gasket.

NOTE: When removing the steering knuckle spindle on a vehicle equipped with the ball joint type axle shaft joint, be prepared for the disconnection of the outer axle shaft from the joint. The joint ball will fall from the joint. Try to cushion its fall or catch it if you can.

11. On those models equipped with the ball type axle shaft joint, slide the inner front axle shaft out of the axle housing. On

those models equipped with the Birfield constant velocity joint type of axle joint, remove the entire axle shaft assembly from the axle housing.

12. Remove bushing from inside of knuckle spindle with a bearing puller. Install new bushing using a metal tube as a seating tool.

13. Remove axle housing oil seal with a bearing puller. To install, use a metal tube as a seating tool.

14. Install the axle shaft in the reverse order of removal. On those models equipped with the ball joint type axle joint, install the inner axle with its proper spacer in position until the splines are fully meshed with the differential side gear splines. Next, fill the steering knuckle three quarters full with grease and place the joint ball on the inner shaft end. Install the outer shaft and the front axle shaft spacer into the steering knuckle spindle and install the spindle with its gasket onto the steering knuckle.

15. On those models equipped with the Birfield constant velocity joint axle joint, install the axle into the housing and rotate the axle shaft until its splines mesh with the splines in the differential. Fill the steering knuckle housing three quarters full with grease and install the steering knuckle spindle.

16. Adjust the wheel bearing preload.

7 DRIVE TRAIN

Front Differential

REMOVAL AND INSTALLATION

Truck and 4Runner

1. Elevate and support the front of the truck. Double check the placement and security of the stands.
 2. Drain the differential oil.
 3. Place matchmarks on the flanges and disconnect the propeller shaft.
 4. Matchmark the driveshafts and side gear shafts. Remove the 6 nuts and disconnect the front driveshafts.
 5. If equipped with A.D.D., disconnect the vacuum hoses and the 4WD indicator switch connector.
 6. Remove the front mounting bolt and nut.
 7. Support the differential with a floor jack. Remove the left and right rear mounting bolts and remove the front differential.
- To install:**
8. Support the differential and place it under the vehicle. Install the left and right rear mounting bolts, tightening them to 123 ft. lbs. (167 Nm).
 9. Install the front mounting bolt, tightening it to 108 ft. lbs. (147 Nm.)
 10. If equipped with A.D.D., connect the hoses and the 4WD switch connector.
 11. Align the matchmarks and install the driveshafts. Tighten the nuts to 61 ft. lbs. (83 Nm).
 12. Align the matchmarks and install the propeller shaft to the companion flange. Tighten the nuts to 54 ft. lbs. (74 Nm).
 13. Install the drain plug if removed or double check its tightness. Install the correct amount of lubricant. Lower the vehicle to the ground.
 14. Road test the vehicle, checking for noise and/or leaks.

Land Cruiser

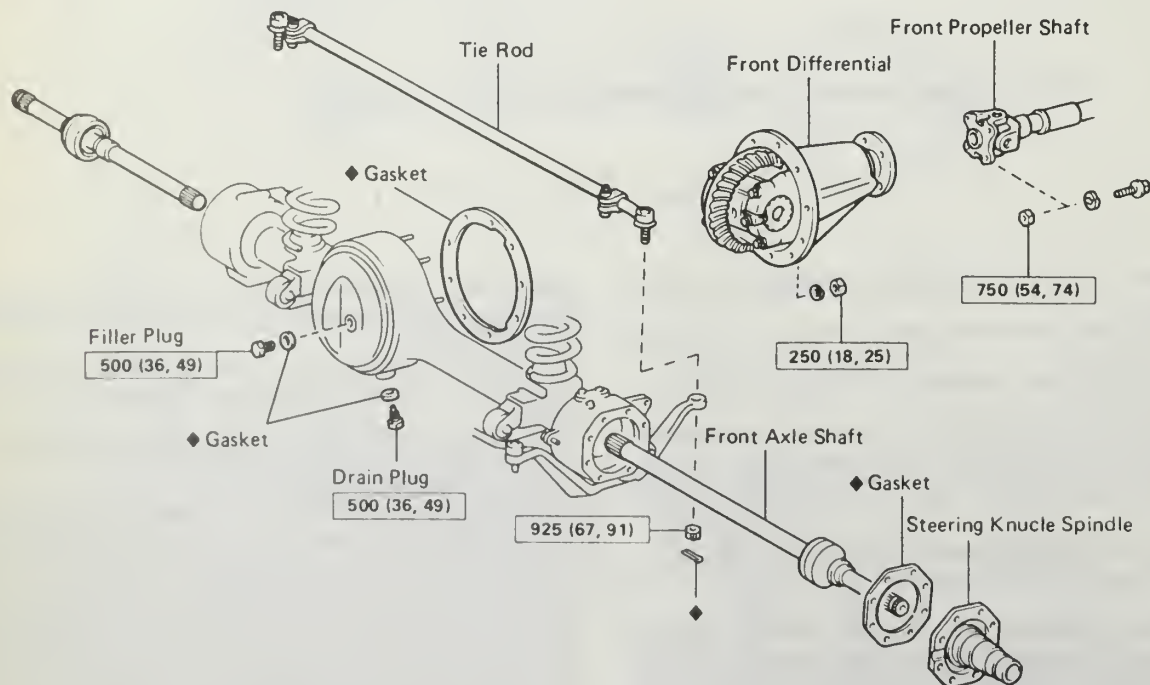
1. Elevate and safely support the vehicle on stands. Double check the security and placement of the stands.
 2. Drain the differential oil.
 3. Remove the front axle shafts.
 4. Remove the cotter pin and castle nut from each end of the steering tie rod. Use a ball joint separator (NEVER a hammer) to separate the tie rod joints; remove the tie rod.
 5. Disconnect the front shaft. Make matchmarks first.
 6. Remove the ring of nuts holding the carrier and remove the carrier assembly. Do not scratch the installation surfaces during removal.
- To install:**
7. Place a new gasket in position on the housing. Fit the carrier into the axle and install the 10 nuts. Tighten the nuts to 18 ft. lbs. (25 Nm).
 8. Connect the front driveshaft.
 9. Install the tie rod.
 10. Install the front driveshafts.
 11. Install the drain plug if it was removed or double check its tightness. Install the proper amount of gear oil. Lower the vehicle to the ground.
 12. Test drive the vehicle.

Rear Oil Seal

REMOVAL AND INSTALLATION

Truck and 4Runner

1. Elevate and safely support the vehicle.
2. Drain the differential oil.
3. Make matchmarks and remove the propeller shaft.



kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

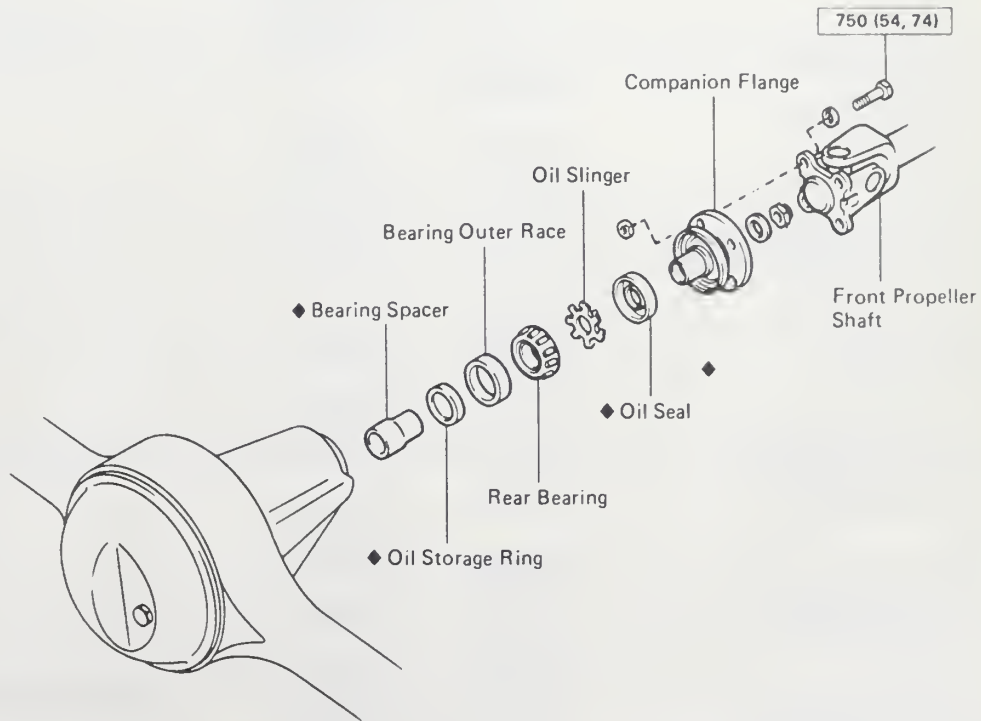
Land Cruiser front differential carrier assembly

4. Loosen the staked part of the companion flange nut. Use a counterhold tool on the flange and remove the nut.
5. Use screw type extractor to remove the companion flange.
6. Use an extractor to remove the oil seal and oil slinger.
7. Install the oil slinger and a new seal. Use the correct size driver to install the seal; drive it in to a depth of 1.5mm below the lip.
8. Apply a coat of multi-purpose grease to the inner lip of the seal. Install the companion flange.
9. Coat the threads of a NEW nut with multi-purpose grease. Counterhold the flange and tighten the nut to 89 ft. lbs. (120 Nm).
10. Use a torque wrench to measure pinion bearing preload. Correct preload is 5.2–8.7 inch lbs. (0.6–1.0 Nm).
11. If preload is greater than specified, replace the bearing spacer. If preload is less than specified, tighten the companion flange nut in 9 ft. lb. (13 Nm.) increments until the correct preload is achieved. Maximum torque for the nut is 165 ft. lbs (223 Nm). If this value is exceeded, the bearing spacer must be replaced; do NOT back off the flange nut to lower torque or preload.
12. Check the runout at the companion flange; maximum runout is 0.10 mm.
13. Stake the pinion flange nut.
14. Fill the differential with the correct amount of fluid.
15. Install the front propeller shaft.
16. Lower the vehicle to the ground.

Land Cruiser

1. Elevate and safely support the vehicle.

2. Make matchmarks and disconnect the front propeller shaft.
3. Loosen the staked part of the companion flange nut. Use a counterhold tool on the flange and remove the nut.
4. Use screw type extractor to remove the companion flange.
5. Use an extractor to remove the oil seal and oil slinger.
6. Install the oil slinger and a new seal. Use the correct size driver to install the seal; drive it in to a depth of 1.0mm below the lip.
7. Apply a coat of multi-purpose grease to the inner lip of the seal. Install the companion flange.
8. Coat the threads of a NEW nut with multi-purpose grease. Counterhold the flange and tighten the nut to 145 ft. lbs. (196 Nm).
9. Use a torque wrench to measure pinion bearing preload. Correct preload is 4.3–6.9 inch lbs. (0.5–0.8 Nm).
10. If preload is greater than specified, replace the bearing spacer. If preload is less than specified, tighten the companion flange nut in 9 ft. lb. (13 Nm.) increments until the correct preload is achieved. Maximum torque for the nut is 253 ft. lbs. (343 Nm). If this value is exceeded, the bearing spacer must be replaced; do NOT back off the flange nut to lower torque or preload.
11. Check the runout at the companion flange; maximum runout is 0.10 mm.
12. Stake the pinion flange nut.
13. Fill the differential with the correct amount of fluid.
14. Install the front propeller shaft.
15. Lower the vehicle to the ground.



kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

Land Cruiser front differential rear seal replacement

7 DRIVE TRAIN

NOISE DIAGNOSIS

The Noise Is	Most Probably Produced By
• Identical under Drive or Coast • Different depending on road surface • Lower as the car speed is lowered • Similar with car standing or moving • A vibration	• Road surface, tires or front wheel bearings • Road surface or tires • Tires • Engine or transmission • Unbalanced tires, rear wheel bearing, unbalanced driveshaft or worn U-joint
• A knock or click about every 2 tire revolutions • Most pronounced on turns • A steady low-pitched whirring or scraping, starting at low speeds • A chattering vibration on turns	• Rear wheel bearing • Damaged differential gears • Damaged or worn pinion bearing
• Noticed only in Drive, Coast or Float conditions	• Wrong differential lubricant or worn clutch plates (limited slip rear axle) • Worn ring gear and/or pinion gear

TORQUE SPECIFICATIONS

Component	English	Metric
MANUAL TRANSMISSION		
External Fasteners		
Backup light switch:	60 inch lbs.	7 Nm
Clutch release cylinder bolts:	9 ft. lbs.	12 Nm
Dust cover-to-bracket		
4WD Pickup and 4Runner		
R150F and G58:	17 ft. lbs.	23 Nm
W56:	29 ft. lbs.	39 Nm
Dynamic damper		
4WD Pickup and 4Runner:	27 ft. lbs.	37 Nm
Exhaust pipe bracket-to-clutch housing		
4WD Pickup and 4Runner		
3VZ-E:	14 ft. lbs.	19 Nm
Exhaust pipe-to-manifold:	46 ft. lbs.	62 Nm
Exhaust pipe-to-catalyst		
3VZ-E:	29 ft. lbs.	39 Nm
Frame auxiliary crossmember:	70 ft. lbs.	95 Nm
Front Carrier cover-to-frame bolts		
4WD Pickup and 4Runner		
3VZ-E:	108 ft. lbs.	147 Nm
All others:	123 ft. lbs.	167 Nm
Lower clutch housing clamp bolt		
4WD Pickup and 4Runner:	14 ft. lbs.	19 Nm
Lower pipe bracket bolts		
22R-E:	51 ft. lbs.	69 Nm
No.2 frame crossmember bolts		
4WD Pickup and 4Runner:	70 ft. lbs.	95 Nm
Rear engine mount and bracket		
2-WD Pickup:	19 ft. lbs.	25 Nm
4WD Pickup and 4Runner:	19 ft. lbs.	25 Nm
Rear engine mount-to-support member		
2-WD Pickup:	43 ft. lbs.	59 Nm

TORQUE SPECIFICATIONS

Component	English	Metric
MANUAL TRANSMISSION		
External Fasteners		
Stabilizer bar retaining bolts:	22 ft. lbs.	29 Nm
Starter bolts:	29 ft. lbs.	39 Nm
Stiffener plate bolts		
2-WD Pickup:	27 ft. lbs.	37 Nm
4WD Pickup and 4Runner:	27 ft. lbs.	37 Nm
Transfer case-to-transmission bolts		
4WD Pickup and 4Runner:	28 ft. lbs.	38 Nm
Transmission housing-to-engine bolts		
2-WD Pickup:	53 ft. lbs.	72 Nm
4WD Pickup and 4Runner:	53 ft. lbs.	72 Nm
Transmission-to-rear mount		
2-WD Pickup:	22 ft. lbs.	29 Nm
4WD Pickup and 4Runner:	9 ft. lbs.	13 Nm
Upper pipe bracket bolts		
22R-E:	14 ft. lbs.	19 Nm
Upper clutch housing clamp bolt		
4WD Pickup and 4Runner:	14 ft. lbs.	19 Nm
Manual Transmission Overhaul		
Backup light switch		
G-Series:	27 ft. lbs.	37 Nm
R-Series		
4-cylinder engines:	27 ft. lbs.	37 Nm
6-cylinder engines:	33 ft. lbs.	44 Nm
Clutch housing-to-case bolts		
G-Series:	27 ft. lbs.	37 Nm
R-Series:	27 ft. lbs.	37 Nm
Countershaft locknut		
G-Series:	87 ft. lbs.	118 Nm
R-Series:	94 ft. lbs.	127 Nm
Extension housing locking ball plug		
R-Series:	14 ft. lbs.	19 Nm
Extension housing mounting bolts		
R-Series:	27 ft. lbs.	37 Nm
Front bearing retainer bolts		
G-Series:	12 ft. lbs.	16 Nm
R-Series:	12 ft. lbs.	17 Nm
Front plug cover		
G-Series:	27 ft. lbs.	37 Nm
Intermediate plate screw plugs		
R-Series:	14 ft. lbs.	20 Nm
Rear bearing retainers		
G-Series:	13 ft. lbs.	18 Nm
R-Series:	13 ft. lbs.	18 Nm
Restrict pin		
G-Series:	20 ft. lbs.	27 Nm
R-Series:	27 ft. lbs.	37 Nm
Reverse idler gear shaft retaining bolt		
G-Series:	13 ft. lbs.	18 Nm
Reverse shift arm bracket		
R-Series:	13 ft. lbs.	18 Nm
Shift fork shaft screw plugs		
G-Series:	14 ft. lbs.	19 Nm
R-Series:	14 ft. lbs.	20 Nm

7 DRIVE TRAIN

TORQUE SPECIFICATIONS

Component	English	Metric
Manual Transmission Overhaul		
Shift lever housing bolt		
G-Series:	28 ft. lbs.	38 Nm
R-Series:	28 ft. lbs.	38 Nm
Shift lever retainer		
G-Series:	13 ft. lbs. 18 Nm	
R-Series:	13 ft. lbs.	18 Nm
Side locking ball screw plug		
G-Series:	14 ft. lbs.	19 Nm
Transfer case adapter bolts		
G-Series:	27 ft. lbs.	37 Nm
R-Series:	27 ft. lbs.	37 Nm
CLUTCH		
Clutch pressure plate:	14 ft. lbs.	19 Nm
Master cylinder mounting bolts:	9 ft. lbs.	13 Nm
Slave cylinder bolts:	9 ft. lbs.	12 Nm
AUTOMATIC TRANSMISSION		
Converter-to-flywheel bolts		
A43D and A44D:	20 ft. lbs.	27 Nm
A340E:	30 ft. lbs.	41 Nm
A440F:	21 ft. lbs.	28 Nm
A340F and A340H		
4-cylinder:	20 ft. lbs.	27 Nm
6-cylinder:	30 ft. lbs.	41 Nm
Crossmember-to-frame bolts		
A440F		
Bolts:	45 ft. lbs.	61 Nm
Nuts:	43 ft. lbs.	59 Nm
Exhaust pipe-to-tailpipe clamp bolt:	32 ft. lbs.	43 Nm
Neutral start switch:	35-60 inch lbs.	4-7 Nm
Oil cooler lines-to-transmission fittings		
A43D, A44D and A340E:	23 ft. lbs.	31 Nm
A440F:	25 ft. lbs.	34 Nm
Rear mounting bracket bolts		
A43D:	43 ft. lbs.	58 Nm
Rear support member		
A340F and A340H:	70 ft. lbs.	95 Nm
Rear mount-to-transmission		
A440F:	43 ft. lbs.	59 Nm
Transfer Position Switch bolt:	48 inch lbs.	5 Nm
Transfer shift lever bolts		
A440F:	13 ft. lbs.	18 Nm
Crossmember-to-frame bolts		
A43D, A44D and A340E:	70 ft. lbs.	95 Nm
Transmission filter or strainer		
All exc. the A440F:	48 inch lbs.	6 Nm
A440F		
8mm bolts:	48 inch lbs.	6 Nm
10mm bolts:	7 ft. lbs.	10 Nm
Transmission pan		
A43D and A44D:	48 inch lbs.	6 Nm
A340E, F and H:	65 inch lbs.	7 Nm
A440F:	61 inch lbs.	7 Nm

TORQUE SPECIFICATIONS

Component	English	Metric
AUTOMATIC TRANSMISSION		
Transmission-to-engine bolts		
A43D, A44D and A340E:	47 ft. lbs.	64 Nm
A340F and A340H:	47 ft. lbs.	64 Nm
A440F:	53 ft. lbs.	72 Nm
Transmission-to-crossmember		
A43D, A44D and A340E:	18 ft. lbs.	25 Nm
TRANSFER CASE		
External Fasteners		
Transfer case-to-transmission:	29 ft. lbs.	39 Nm
Rear engine mount:	19 ft. lbs.	25 Nm
Transfer Case Overhaul		
Differential actuator motor		
HF2A:	9 ft. lbs.	12 Nm
Extension housing-to-case		
RF1A:	30 ft. lbs.	41 Nm
VF1A:	8 ft. lbs.	11 Nm
HF2A:	27 ft. lbs.	37 Nm
4WD indicator switch		
HF2A:	27 ft. lbs.	37 Nm
Front and rear cases		
VF1A:	27 ft. lbs.	37 Nm
HF2A:	27 ft. lbs.	37 Nm
Front and rear flanges		
RF1A:	90 ft. lbs.	123 Nm
VF1A:	87 ft. lbs.	118 Nm
Front bearing retainer		
RF1A:	10 ft. lbs.	14 Nm
Front drive gear bearing retainer		
RF1A:	14 ft. lbs.	19 Nm
Front retainer		
VF1A:	8 ft. lbs.	11 Nm
L4 position switch		
22R-E/340F:	27 ft. lbs.	37 Nm
Oil pump body		
VF1A:	8 ft. lbs.	11 Nm
Oil receiver-to-front case		
HF2A:	48 inch lbs.	5 Nm
Outer lever and inner shift lever lock pin		
HF2A:	9 ft. lbs.	12 Nm
Oil strainer-to-rear case		
HF2A:	43 inch lbs.	5 Nm
Planetary ring gear plug		
VF1A:	14 ft. lbs.	19 Nm
Rear case bolts		
RF1A:	30 ft. lbs.	41 Nm
Reduction gear case-to-front case		
RF1A:	30 ft. lbs.	41 Nm
Selector return spring-to-control retainer		
3VZ-E/R150F:	13 ft. lbs.	18 Nm

7 DRIVE TRAIN

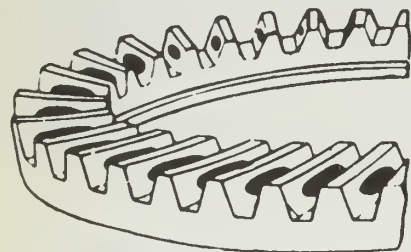
TORQUE SPECIFICATIONS

Component	English	Metric
Transfer Case Overhaul		
Shift fork side plugs		
RF1A:	10 ft. lbs.	14 Nm
VF1A:	14 ft. lbs.	19 Nm
HF2A:	14 ft. lbs.	19 Nm
Speedometer driven gear lock plate bolt		
VF1A:	8 ft. lbs.	11 Nm
Strainer and separator		
VF1A:	13 ft. lbs.	18 Nm
Transfer indicator switch		
VF1A:	27 ft. lbs.	37 Nm
DRIVELINE		
Center bearing-to-crossmember		
4WD Pickup and 4Runner:	27 ft. lbs.	36 Nm
Center bearing-to-intermediate shaft nut		
4WD Pickup and 4Runner		
Step 1:	134 ft. lbs.	181 Nm
Step 2:	51 ft. lbs.	69 Nm
Land Cruiser		
Step 1:	134 ft. lbs.	181 Nm
Step 2:	51 ft. lbs.	69 Nm
Front driveshaft-to-axle flange bolts:	54 ft. lbs.	74 Nm
Front driveshaft-to-intermediate shaft		
4WD Pickup and 4Runner:	54 ft. lbs.	74 Nm
Front driveshaft-to-transfer case flange		
4WD Pickup and 4Runner:	54 ft. lbs.	74 Nm
Rear driveshaft-to-axle flange bolts		
2WD Pickup		
Exc 3VZ-E and man. Trans.:	54 ft. lbs.	74 Nm
with 3VZ-E and man. trans.:	56 ft. lbs.	76 Nm
4WD Pickup and 4Runner:	54 ft. lbs.	74 Nm
Land Cruiser:	65 ft. lbs.	88 Nm
Trucks with 2-piece driveshaft:	22-36 ft. lbs.	30-49 Nm
Rear driveshaft-to-center flange		
4WD Pickup and 4Runner:	54 ft. lbs.	74 Nm
REAR DRIVE AXLE		
Brake backing plate nuts		
Pickups and 4Runner:	51 ft. lbs.	69 Nm
Carrier assembly mounting bolts		
Pickup and 4Runner:	to 18 ft. lbs.	25 Nm
Land Cruiser:	34 ft. lbs.	47 Nm
Companion flange nut		
Trucks and 4Runners:	145 ft. lbs.	196 Nm
Land Cruisers:	181 ft. lbs.	245 Nm
Differential bearing cap bolts		
Truck and 4Runner:	58 ft. lbs.	78 Nm
Land Cruiser:	58 ft. lbs.	78 Nm
Differential case halves		
Trucks and 4Runner:	35 ft. lbs.	47 Nm

TORQUE SPECIFICATIONS

Component	English	Metric
REAR DRIVE AXLE		
Drive pinion preload		
Trucks and 4Runner		
New bearing, 4-pinion:	8.7–13.9 inch lbs.	1.0–1.6 Nm
New bearing, 2-pinion:	16.5–22.6 inch lbs.	1.9–2.5 Nm
Used bearing, 4-pinion:	4.3–6.9 inch lbs.	0.5–0.8 Nm
Used bearing, 2-pinion:	7.8–11.3 inch lbs.	0.9–1.3 Nm
Land Cruiser		
New bearing:	11.3–17.4 inch lbs.	1.3–2.0 Nm
Used bearing:	6.1–8.7 inch lbs.	0.7–1.0 Nm
Pinion shaft pin		
Land Cruiser:	20 ft. lbs.	27 Nm
Ring gear bolts		
Trucks and 4Runner:	71 ft. lbs.	97 Nm
Ring gear nuts		
Land Cruiser:	81 ft. lbs.	110 Nm
FRONT DRIVE AXLE		
Axle shaft inner mounting nuts		
Pickup and 4Runner:	61 ft. lbs.	83 Nm
Companion flange nut		
Truck and 4Runner:	89 ft. lbs.	120 Nm
Land Cruiser:	145 ft. lbs.	196 Nm
Hub bearing adjusting nut		
Pickup and 4Runner		
Step 1:	43 ft. lbs.	59 Nm
Step 2:	18 ft. lbs.	25 Nm
Hub bearing locknut		
Pickup and 4Runner:	58 ft. lbs.	78 Nm
Differential carrier mounting nuts		
Land Cruiser:	18 ft. lbs.	25 Nm
Differential front mounting bolt		
Truck and 4Runner:	108 ft. lbs.	147 Nm
Differential rear mounting bolts		
Truck and 4Runner:	123 ft. lbs.	167 Nm
Driveshaft flange nuts		
Truck and 4Runner:	61 ft. lbs.	83 Nm
Pinion bearing preload		
Truck and 4Runner:	5.2–8.7 inch lbs.	0.6–1.0 Nm
Land Cruiser:	4.3–6.9 inch lbs.	0.5–0.8 Nm

7 DRIVE TRAIN

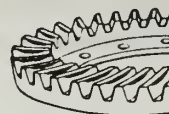


Proper Contact

Heel Contact



Face Contact



Select an adjusting shim that will bring the drive pinion closer to the ring gear.

Toe Contact



Flank Contact



Select an adjusting shim that will shift the drive pinion away from the ring gear.

Washer thickness

Thickness mm (in.)	
2.24 (0.0882)	2.51 (0.0988)
2.27 (0.0894)	2.54 (0.1000)
2.30 (0.0906)	2.57 (0.1012)
2.33 (0.0917)	2.60 (0.1024)
2.36 (0.0929)	2.63 (0.1035)
2.39 (0.0941)	2.66 (0.1047)
2.42 (0.0953)	2.69 (0.1059)
2.45 (0.0965)	2.72 (0.1071)
2.48 (0.0976)	

Suspension and Steering

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8 SUSPENSION AND STEERING

Troubleshooting Basic Steering and Suspension Problems

Problem	Cause	Solution
Hard steering (steering wheel is hard to turn)	• Low or uneven tire pressure • Loose power steering pump drive belt • Low or incorrect power steering fluid • Incorrect front end alignment • Defective power steering pump • Bent or poorly lubricated front end parts	• Inflate tires to correct pressure • Adjust belt • Add fluid as necessary • Have front end alignment checked/adjusted • Check pump • Lubricate and/or replace defective parts
Loose steering (too much play in the steering wheel)	• Loose wheel bearings • Loose or worn steering linkage • Faulty shocks • Worn ball joints	• Adjust wheel bearings • Replace worn parts • Replace shocks • Replace ball joints
Car veers or wanders (car pulls to one side with hands off the steering wheel)	• Incorrect tire pressure • Improper front end alignment • Loose wheel bearings • Loose or bent front end components • Faulty shocks	• Inflate tires to correct pressure • Have front end alignment checked/adjusted • Adjust wheel bearings • Replace worn components • Replace shocks
Wheel oscillation or vibration transmitted through steering wheel	• Improper tire pressures • Tires out of balance • Loose wheel bearings • Improper front end alignment • Worn or bent front end components	• Inflate tires to correct pressure • Have tires balanced • Adjust wheel bearings • Have front end alignment checked/adjusted • Replace worn parts
Uneven tire wear	• Incorrect tire pressure • Front end out of alignment • Tires out of balance	• Inflate tires to correct pressure • Have front end alignment checked/adjusted • Have tires balanced

WHEELS

REMOVAL AND INSTALLATION

1. Remove the ornamental wheel cover, if present.
2. Before jacking up the vehicle, loosen the wheel bolts. This may be easier said than done, particularly if the wheels haven't been removed in quite a while or if an unthinking mechanic used an air gun to tighten the nuts last time. Use penetrating oil if necessary. Don't apply excess force with a ratchet; the mechanism may break under load. Use a breaker bar (socket driver without a ratchet) or a long 4-way tire iron. Loosen each bolt about half a turn but no more.
3. Elevate and safely support the vehicle with jackstands. Make sure the vehicle is on level ground and the opposite wheels are blocked to prevent rolling. Depending on the wheel to be removed, supporting only one end is acceptable if the stands are firmly placed under the frame rails.

4. Remove the wheel nuts. Remove the wheel. Tires and wheels are heavy, bulky and dirty; be ready.

5. Before reinstallation, clean the lugs and bolt threads, removing all traces of dirt, rust and grime. Clean the contact face of the wheel, both front (bolt side) and rear.

6. Install the wheel by holding it in position on the ground with the bolt holes in the same relative positions as the bolts. Lift the wheel and fit it onto the bolts.

7. Install the lug bolts finger tight. The wheel is most likely hanging at an angle on the bolts; push in on the bottom when installing the lower bolts.

8. Use the wrench to tighten the bolts snug. Tighten the bolts in a star or criss-cross pattern, drawing the wheel tight to the mount. Make a second pass to double check that each is snug.

9. Lower the vehicle to the ground. Use a torque wrench to repeat the star pattern and draw each nut to its final torque. It's

best to make 2 passes, each about "half the distance" to the correct tightness; in this fashion the wheel is drawn evenly into place.

- Trucks, 2WD, steel wheels, single rear wheels: 101 ft. lbs. (137 Nm)
- Trucks, 2WD, steel wheels, dual rear wheels: 170 ft. lbs. (230 Nm)
- Truck, 4WD: steel or aluminum wheels: 76 ft. lbs. (103 Nm).
- 4Runner, steel or aluminum wheels: 76 ft. lbs. (103 Nm).
- Land Cruiser: 116 ft. lbs. (157 Nm).

10. Install the wheel trim or cover if it was removed. Check the area carefully for any tools left around or under the vehicle.

INSPECTION

Even with the tire mounted, the wheel can still be inspected visually for any sign of damage. Check the flange area at the tire bead carefully for any signs of cracking or bending. Impact, such as from a hole, can damage the wheel flange. Inspect the lug nut area for any sign of cracking or deterioration. Styled or spoked wheels should be closely examined at the base of each runner.

With the tire off the wheel, the inner surfaces of the wheel may be examined for failing welds, cracks, etc. For very expensive alloy or aftermarket wheels, having them crack checked by a machine shop is a good investment. For everyday steel wheels, it may be cheaper to replace the wheel.

Never attempt to straighten a bent steel wheel; you're not that good. A steel wheel will always have a slight bend, resulting in either slow leaks at the bead or a wobble which eats tires. Alloy or styled wheels can't be straightened at all; if hit, they shatter.

Wheel Lugs

REMOVAL AND REPLACEMENT

Front

1. Elevate and safely support the vehicle.
2. Remove the wheel.
3. Disconnect the brake line from the front caliper. Plug the line immediately.
4. Remove the brake caliper.

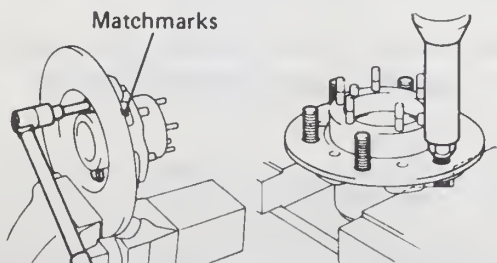
CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

5. For Trucks and 4Runners with free-wheeling hubs, remove the hub.

- a. For all other trucks and 4Runners, remove the cap from the flange and remove the center bolt. On Land Cruiser, remove the snapping.

- b. Remove the 6 mounting nuts.



After making matchmarks on the hub and disc, use a press to replace the front wheel lugs

- c. Use a brass bar and hammer to tap on the bolt heads and remove the cone washers.

- d. On Land Cruiser, pull out the flange. For truck and 4Runner, install and tighten 2 bolts, using them to force the flange loose.

6. Remove the lock washer on the hub.

7. Remove the lock nut and the lock washer.

8. Remove the adjusting nut.

9. Remove the axle hub with the brake disc attached.

CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

10. Place matchmarks on the hub and brake disc. The units must be reinstalled in their exact relationship as before.

11. Remove the 6 bolts holding the disc to the hub.

12. Install a lug nut on the lug to be removed, tightening it only the length of the nut. Use a press and extension bar to force the lug from the disc. Remove the nut and remove the lug.

To install:

13. Reverse the disc and use the press to install the new lug. Make sure it is firmly and completely seated in the disc.

14. Align the matchmarks and place the hub on the disc. Install the 6 bolts, tightening them to 47 ft. lbs. (64 Nm).

15. Install the disc and hub on the knuckle or spindle. Make certain the outer bearing is in place. Install the thrust washer(s).

16. Install the bearing adjusting nut (spindle nut) and tighten to 43 ft. lbs. (59 Nm). Turn the hub right and left 2-3 times to seat the bearings. Loosen the adjusting nut until it can be turned with the fingers.

17. Retighten the adjusting nut. On Land Cruiser, tighten it to 48 ft. lbs. (54 Nm); for Truck and 4Runner, tighten it to 18 ft. lbs. (25 Nm).

18. Use a spring tension gauge to check starting preload on the hub. The hub should turn with a force of 6.4-12.6 lbs.

19. Install the lock washer and lock nut. Tighten the Truck and 4Runner lock nut to 35 ft. lbs. (47 Nm) and the Land Cruiser lock nut to 47 ft. lbs. (63 Nm). Check that the wheel bearing has no play.

20. On 4WD Truck and 4Runner with free-wheeling hubs, install the free-wheeling hub.

21. For all other vehicles, install a new gasket on the axle hub. Install the flange to the hub and install the 6 washers and nuts. Tighten the truck and 4Runner nuts to 23 ft. lbs. (31 Nm) and the Land Cruiser nuts to 26 ft. lbs. (35 Nm).

22. On Trucks and 4Runner, install the bolt and cap.

23. On Land Cruiser, use a bolt threaded into the end of the axle to pull it outwards; install the snapping and remove the bolt. Install the cap.

24. For 2WD vehicles, install the grease cap with a new gasket and tighten the 6 bolts to 9 ft. lbs. (13 Nm).

25. Install the brake caliper. Tighten the bolts to 90 ft. lbs. (123 Nm).

26. Connect the brake line to the caliper; tighten the fitting to 11 ft. lbs. (15 Nm).

27. Bleed the brake system.

28. Install the wheel.

29. Lower the vehicle to the ground.

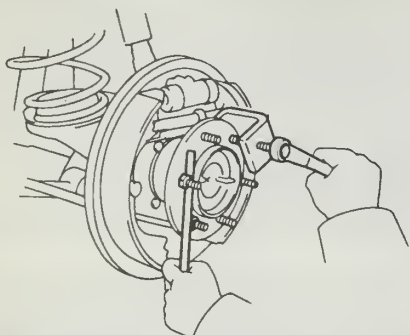
Rear

1. Elevate and safely support the vehicle.

2. Remove the wheel.

3. Remove the brake drum.

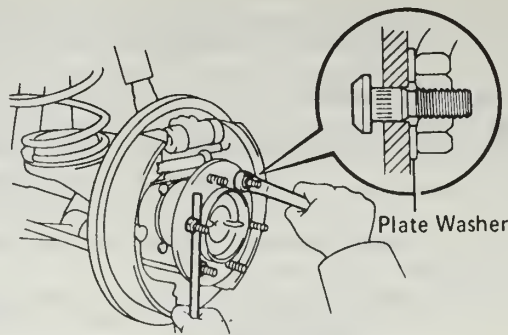
8 SUSPENSION AND STEERING



The proper tool can save axle removal when replacing the rear wheel lugs

CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.



Once in place, use a flat washer and a lug nut to pull the new rear lug into place

to press out the lug. Note that this can be done with the axle and brakes in place if you're careful.

5. Fit the new lug into the hole. Place a flat washer over the lug and install a lug nut on the new lug. Use a hand wrench to tighten the nut, drawing the lug into position. Remove the nut when the lug is fully seated.

6. Install the brake drum.

7. Install the wheel.

8. Lower the vehicle to the ground.

4. Use a lug extractor such as tool 09650-17011 or equivalent

FRONT SUSPENSION

Leaf Springs and Shock Absorber

REMOVAL AND INSTALLATION

Land Cruiser 1989-90

1. Remove the wheels and then raise the front of the truck and support it on safety stands. Make certain the stands are placed under the frame rails.

2. Position a floor jack under the differential housing and lower it until there is no tension on the leaf springs.

3. Remove the shock absorber.

4. Remove the U-bolt mounting nuts, pull the spring set away and remove the U-bolts.

5. Remove the hanger and shackle pin mounting nuts. Remove the pins and then lift out the leaf spring.

NOTE: It may be necessary to lower the jack under the axle housing to remove spring.

To install:

6. Insert the bushings into the frame and each end of the leaf. Position the spring, install the hanger pin and tighten the bolt to 17 ft. lbs. (24 Nm).

7. Finger tighten the hanger pin nut and install the shackle pin. Install the plate and finger tighten the nuts.

8. Insert the head of the center leaf spring bolt into the hole

in the axle housing bracket and then install the U-bolts onto the leaf. Install the spring seat and nuts. Tighten the nuts to 105 ft. lbs. (142 Nm).

NOTE: When tightening the U-bolts, the exposed length of each bolt below the nut must be the same for all 4 threaded ends.

9. Install the shock absorber.

10. Lower the truck and bounce it a few times to stabilize the suspension.

11. Tighten the hanger pin nut to 90 ft. lbs. (123 Nm). Tighten the shackle pin nut to 67 ft. lbs. (91 Nm).

Coil Spring and Shock Absorber

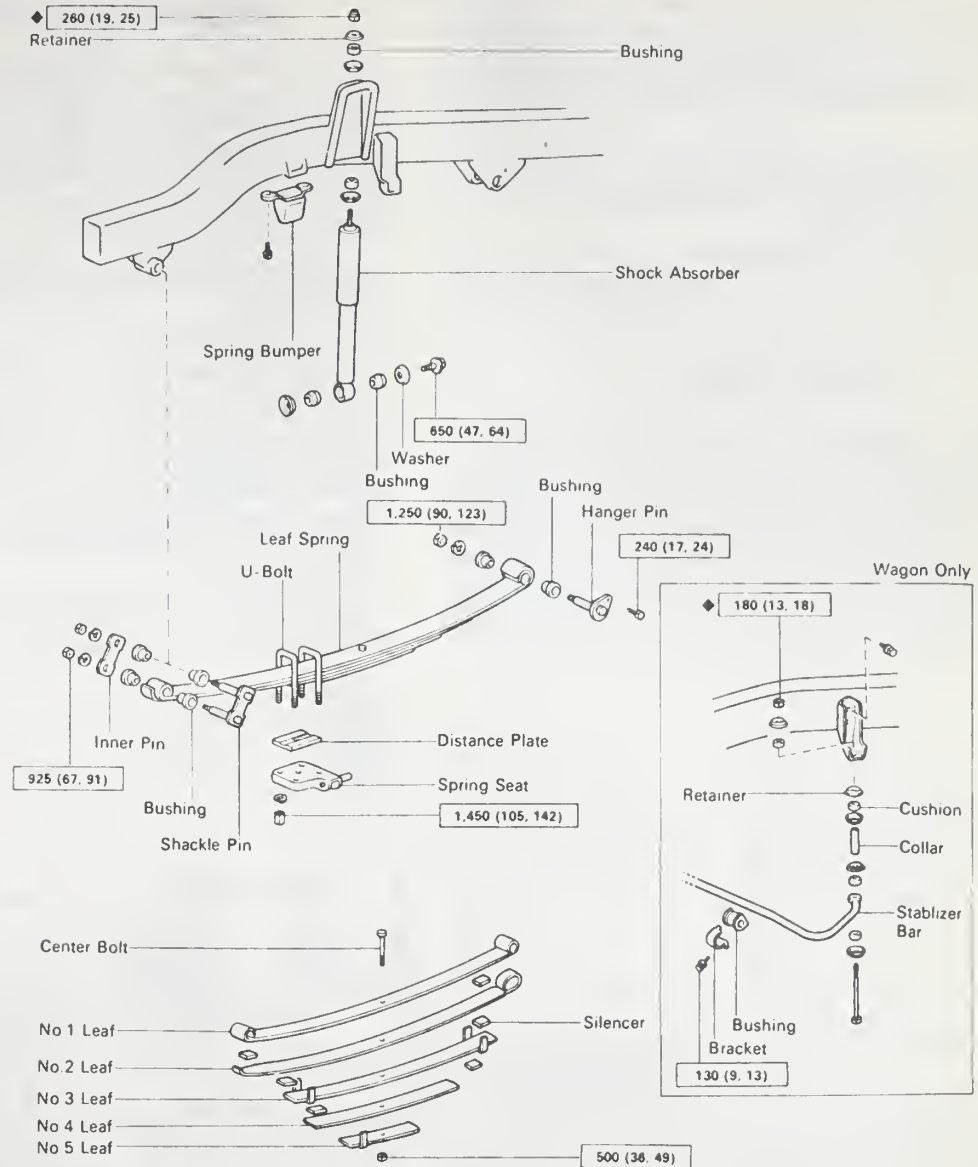
REMOVAL AND INSTALLATION

1991 Land Cruiser

1. Elevate and safely support the vehicle. Make certain the jackstands are securely placed under the frame rails.

2. Use a floor jack to slightly jack and support the front axle housing. Hold the piston rod of the shock absorber and remove the upper mounting nut. Hold the shock and remove the lower mounting nut, the cushions and the retainer.

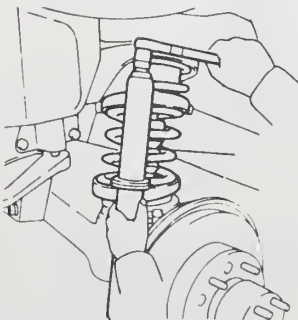
3. Disconnect the stabilizer bar.



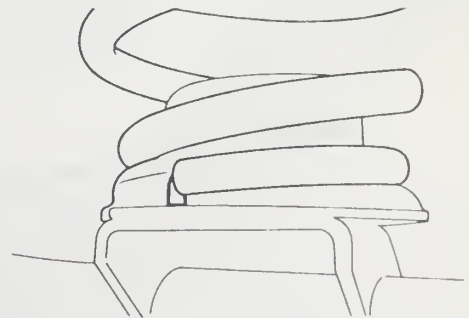
[Kg-cm (ft.-lb, N m)] Specified torque

◆ Non-reusable part

Front leaf spring components — 1989-90 Land Cruiser



The spring compressor **MUST** be properly installed before removing the Land Cruiser coil spring



Make certain the bottom of the spring aligns with the spring seat

8 SUSPENSION AND STEERING

4. Lower the jack holding the front axle. Use a spring compressor to compress the spring. Remove the spring, still compressed, from the vehicle. Place the spring, facing away from you, on the work bench and slowly release the tension on the compressor. When the spring is fully extended, remove the tool.

To install:

5. Compress the spring and fit it into position in the vehicle. Align the end with the lower spring seat; slowly release the compressor, allowing the spring to expand into place.

6. Install the stabilizer bar.

7. Install the shock absorber. Tighten the lower mounting nut to 51 ft. lbs. (69 Nm) and then the upper mount to the same value.

8. Lower the vehicle to the ground.

Torsion Bars

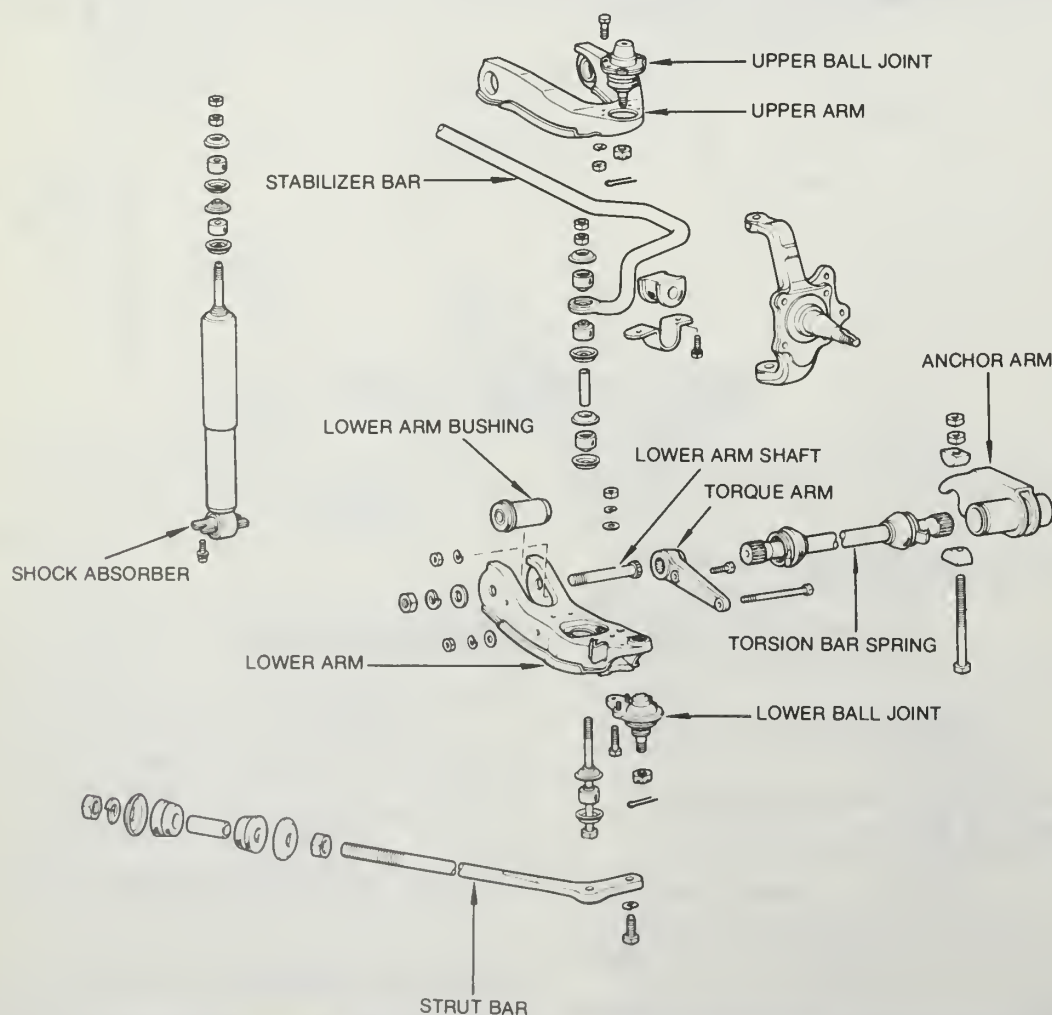
Torsion bars are used in place of coil springs on Trucks and 4Runners. While employing the same torsional principal as a spring, the torsion bars are installed parallel to the ground instead of vertically as is a coil spring. This allows a much more compact suspension arrangement, lower front end styling and better suspension control since the torsion bar need not move through the greater distances traversed by a compression spring. The torsion bars are under tension as is any installed spring and great care must be taken when removing the bars.

REMOVAL AND INSTALLATION

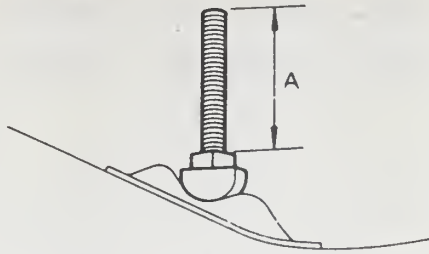
CAUTION

Great care must be taken to make sure torsion bars are not mixed after removal, it is strongly suggested that before removal, each be marked with paint, showing the front and rear of spring and from which side of the truck it was taken. If they are installed backward or on the wrong sides of the truck, they could fracture. New units are marked L or R with an arrow showing direction of flex.

1. Raise the truck and support the frame on stands.
2. Slide the boot from the rear of torsion bar spring housing and onto spring.
3. Follow the same procedure on the front of the spring.
4. Paint matchmarks on the torsion bar spring, anchor arm and torque arm.
5. On the rear torsion bar spring holder, there is a long bolt that passes through the arm of the holder and up through the frame crossmember, using a small ruler, measure the length from the bottom of the retaining nut to the threaded tip of the bolt and record this measurement.
6. Loosen the adjusting nut and remove the anchor arm and torsion bar spring.
7. Inspect all parts for wear, damage or cracks. Check the boot for rips and wear. Inspect the splined ends of the torsion bar spring and the splined holes in the rear holder and the front



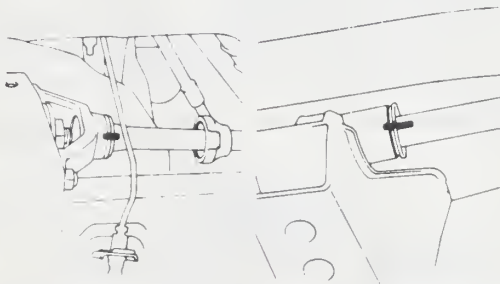
Exploded view of the torsion bar suspension —
Truck and 4Runner



Remove the locking nut and measure this distance



Even though the torsion bars are marked, adding your own marks prevents errors



Additional matchmarks are recommended at disassembly

torque arm for damage. Replace as necessary. On the rear end of the torsion bar springs, there are markings to show which is right and which is the left bar. Do not confuse them.

To install the existing spring:

9. Coat the splined ends of the torsion bar with multipurpose grease.

10. Align the matchmarks and install the torsion bar spring to the torque arm.

11. Align the matchmarks and install the anchor arm to the torsion bar spring.

12. Tighten the adjusting nut so that the bolt protrusion measured previously is equal to that of the new adjustment.

To install a new torsion bar spring:

13. Install the 2 bolts to the torsion bar spring.

14. Lightly coat the spring end splines with grease and then install the anchor arm to the small end of the spring temporarily. Paint matchmarks on the spring and arm.

NOTE: There is one spline on the spring that is larger than the others. When connecting the spring to the arm, turn the arm slowly until you can feel the larger spline match up with the slot in the arm.

15. Remove the anchor arm from the spring and install the spring into the torque arm.

NOTE: There is one spline on the spring that is larger than the others. When connecting the spring to the arm, turn the arm slowly until you can feel the larger spline match up with the slot in the arm.

16. Align the matchmarks and install the anchor arm to the spring. Tighten the adjusting nut so that the exposed thread on the bolt is no greater than 87mm.

All models:

17. Install the locknut and wheels, lower the truck and bounce it several times to set the suspension.

18. Measure the ground clearance and adjust with the adjusting nut. Tighten the locknut to 61 ft. lbs. (83 Nm).

Shock Absorber

TESTING

The purpose of the shock absorber is simply to limit the motion of the spring during compression (bump) and rebound cycles. If the vehicle were not equipped with these motion dampers, the up and down motion of the vehicle would multiply until the vehicle was alternately trying to leap off the ground and to pound itself into the pavement.

Contrary to popular rumor, the shocks do not affect the ride height of the vehicle nor do they affect the ride quality except for limiting the pitch or bounce of the car. These factors are controlled by other suspension components such as springs and tires. Worn shock absorbers can affect handling; if the front of the vehicle is rising or falling excessively, the "footprint" of the tires changes on the pavement and steering response is affected. The simplest test of the shock absorbers is simply to push down on one corner of the unladen vehicle and release it.

Observe the motion of the body as it is released. In most cases, it will come up beyond its original rest position, dip back below it and settle quickly to rest. This shows that the damper is slowing and controlling the spring action. Any tendency to excessive pitch (up-and-down) motion or failure to return to rest within 2-3 cycles is a sign of poor function within the shock absorber.

While each shock absorber can be replaced individually, it is recommended that they be changed as a pair (both front or both rear) to maintain equal response on both sides of the vehicle. Chances are quite good that if one has failed, its mate is weak also.

REMOVAL AND INSTALLATION

1. Remove the hubcap and loosen the lug nuts.
2. Raise front of the truck and support it with safety stands.
3. Remove the wheel.
4. Unfasten the double nuts at the top end of the shock absorber. Remove the cushions and cushion retainers.
5. On 2WD models, remove the 2 bolts which secure the lower end of the shock absorber to the lower control arm. On 4WD models, remove the lower thru-bolt.
6. Remove the shock absorber.
7. Install the shock absorber and tighten the lower mounting nuts/bolt to 13 ft. lbs. (18 Nm) for 2WD; 101 ft. lbs. (137 Nm) for 4WD Truck and 4Runner; 47 ft. lbs. (64 Nm) for 1989-90 Land Cruiser; 51 ft. lbs. (69 Nm) for 1991 Land Cruiser. Tighten the upper mounting nut to 18 ft. lbs. (25 Nm) for all but the 1991 Land Cruiser, which is tightened to 51 ft. lbs. (69 Nm).
8. Install the wheels and lower the truck.

INSPECTION

Once removed, the shock should be carefully inspected for any signs of leakage. Oil-filled shocks may have a light film of oil around the seal, resulting from normal breathing and air exchange. This should NOT be taken as a sign of failure, but any sign of thick or running oil definitely indicates failure. Gas filled shocks may also show some film at the shaft; if the gas has leaked out, the shock will have almost no resistance to motion.

Hold the shock firmly in each hand and compress it; compression should be reasonably even and smooth. Release the piston end; it should return smoothly and at an even pace. Stretch the

8 SUSPENSION AND STEERING

shock, checking again for smooth motion and any abnormal resistance.

DISPOSAL OF GAS-FILLED SHOCK ABSORBERS

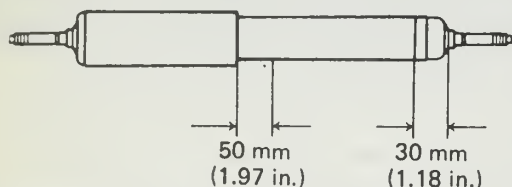
The factory installed gas shocks found on some vehicles contain nitrogen. The gas is under pressure, even with the shock removed from the vehicle. To eliminate the possibility of explosion after disposal, the shock case must be drilled to release the gas.

Drill a 2-3mm hole (0.079-0.118 in) at a point 30mm (1.18 in.) above the base of the shock case. Drill a second hole 50mm (1.97 in) below the edge of the piston cover (with the shock compressed).

CAUTION

Although nitrogen is non-toxic and non-flammable, the escaping gas may carry metal chips from the drill; always wear eye or full-face protection when drilling.

Once the gas is released, the shock absorber may be safely discarded.



Gas-filled shocks must be properly drilled before disposal

Ball Joints

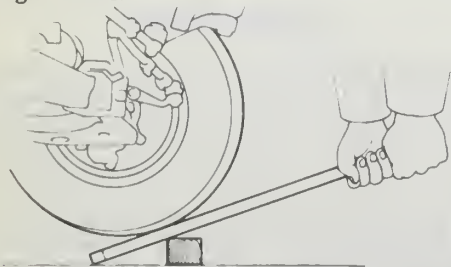
INSPECTION

To check the lower ball joint for wear, jack up the front of the vehicle and support it with stands. Remove excess play from the other suspension parts (wheel bearings, tie rods, etc.). Have an assistant press the brake pedal; Move the lower suspension arm up and down, checking that the lower ball joint has minimal play, if any. The maximum allowable vertical play is 2.3mm. If the play is greater, replace the ball joint. The upper ball joint is subject to the same limit on trucks; the 4Runner upper ball joint must have no play at all (0.0mm play). The upper ball joint is tested by moving the wheel and tire up and down.

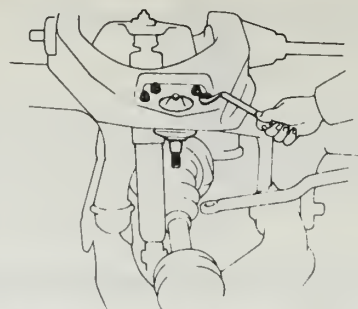
REMOVAL AND INSTALLATION

Truck and 4Runner

1. Raise the vehicle and support it with jackstands.
2. Remove the front wheel.
3. Support the lower control arm with a floor jack and remove the steering knuckle.



Testing ball joint play



The ball joints can be unbolted from the control arms

4. Loosen the mounting bolts and remove the lower ball joint from the lower control arm. On 4WD models, remove the cotter pin and then remove the mounting nut.

5. Unbolt the upper ball joint from the upper control arm.

6. Install the upper ball joint and tighten the bolts to:

- 4Runner: 25 ft. lbs. (33 Nm)

- 2WD Truck: 23 ft. lbs. (31 Nm)

- 4WD Truck: 18 ft. lbs. (25 Nm)

7. On 2WD models, install the lower ball joint and tighten the nut to 94 ft. lbs. (127 Nm). On 4WD models, install the lower ball joint, tighten the nut to 105 ft. lbs. (142 Nm) and install a new cotter pin.

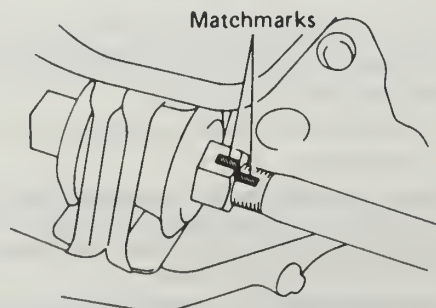
8. Install the steering knuckle. Install the wheels and lower the truck.

Strut Bar

REMOVAL AND INSTALLATION

2WD Truck

1. Remove the wheels, raise the truck and support it on safety stands.
2. Paint matchmarks on the strut bar and retaining nut.
3. Remove the retaining nut from the front of the bar.
4. Remove the nuts holding the bar to the lower control arm and lift out the strut bar.
5. Position the bar and install the front nut so that the matchmarks line up.
6. Slide the washer and bushing onto the bar and install it to the bracket at the rear.
7. Install the collar, bushing and washer to the other side and then connect the rear of the bar to the control arm. Tighten the mounting nut to 70 ft. lbs. (95 Nm).
8. Lower the truck and bounce it several times to set the suspension.
9. Tighten the front nut to 90 ft. lbs. (123 Nm) and check the alignment.



Place matchmarks on the strut rod before removal

Stabilizer Bar (Sway Bar) REMOVAL AND INSTALLATION

2WD Truck

1. Raise the truck and support it on safety stands. Remove the wheels.
2. Remove one torsion bar spring.
3. Remove the nuts and cushions at both sides of the stabilizer bar where it attaches to the control arms.
4. Remove the 2 bushings and brackets at the frame member. Remove the stabilizer bar.

NOTE: Examine the rubber bushings very carefully for any splits or deformation. Clean the inner and outer surfaces of the bushings before reinstallation. Failed or dirty bushings can create a chorus of odd noises under the vehicle, particularly during cornering.

5. Position the stabilizer bar and install the 2 center bushings and brackets to the frame. Finger tighten the bolts.
6. Connect the bar to the control arms on each side. Use new nuts and tighten to 9 ft. lbs. (13 Nm).
7. Tighten the center bracket bolts to 9 ft. lbs. (13 Nm) and install the torsion bar.
8. Install the wheels and lower the truck.

Land Cruiser

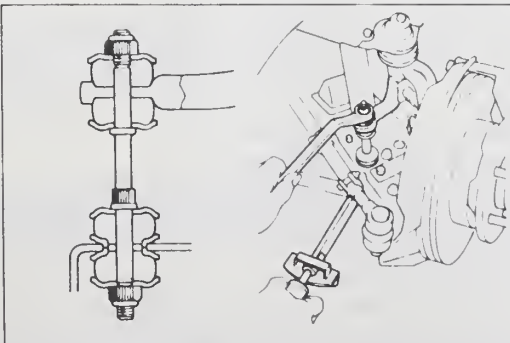
1. Raise the truck and support it on safety stands.
2. Remove the wheels.
3. Remove the nut and disconnect the stabilizer bar with the bracket from the frame.
4. Disconnect the bar from the axle housing. Remove the stabilizer bar. Remove the 2 bolts and remove the bracket from the bar.

NOTE: Examine the rubber bushings very carefully for any splits or deformation. Clean the inner and outer surfaces of the bushings before reinstallation. Failed or dirty bushings can create a chorus of odd noises under the vehicle, particularly during cornering.

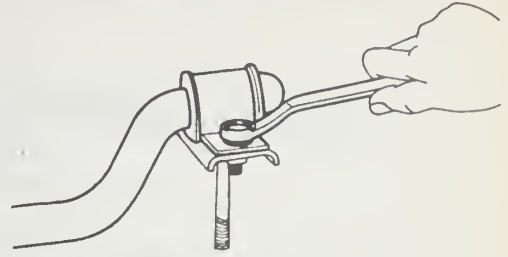
5. Reassemble in reverse order. Tighten the bar-to-bracket bolts to 13 ft. lbs. (18 Nm) before installation. Mount the bar, tightening the fittings just snug.
6. Install the wheels and lower the vehicle to the ground. Bounce the front end several times to stabilize the suspension.
7. Tighten the bolts at the axle tube to 19 ft. lbs. (25 Nm). Tighten the nuts at the top of the small link to 13 ft. lbs. (18 Nm).

4WD Truck and 4Runner

1. Raise the truck and support it on safety stands. Remove the wheels.



The bushings must be correctly placed when reinstalling the 2WD truck stabilizer bar link



The Land Cruiser stabilizer bar is removed with the mounting bracket attached

2. Remove the nuts, cushions and retainers at both sides of the stabilizer bar where it attaches to the lower control arm.
3. Remove the 2 bushings and brackets where the bar mounts to the frame member. Remove the stabilizer bar.
4. Position the stabilizer bar and install the 2 center bushings and brackets to the frame. Finger tighten the bolts.
5. Connect the bar to the control arm on each side. Use new nuts and tighten to 19 ft. lbs. (25 Nm).
6. Tighten the center bracket bolts to 9 ft. lbs. (13 Nm) and install the torsion bar.
7. Install the wheels and lower the truck.

Upper Control Arm

REMOVAL AND INSTALLATION

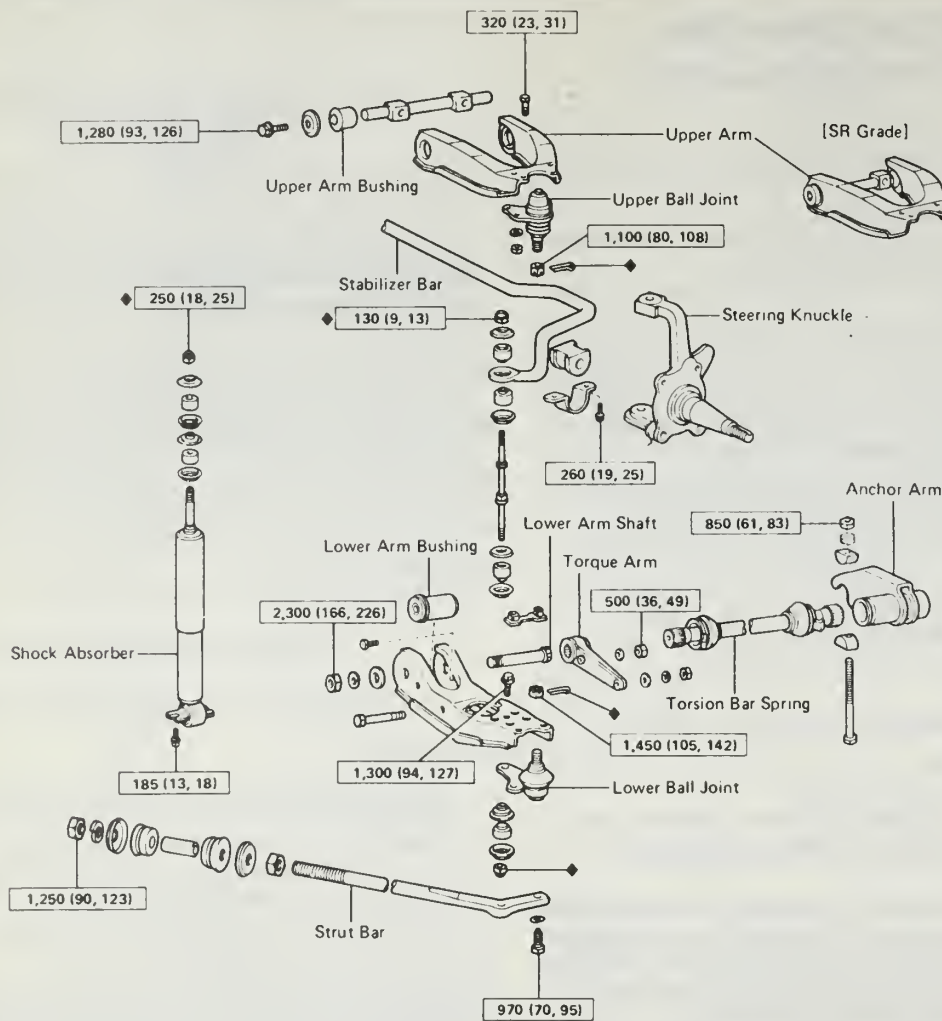
2WD Truck

1. Raise and support the truck under the frame.
2. Remove the wheel.
3. Raise the lower control arm with a floor jack.
4. Remove the 4 nuts from the upper ball joint and disconnect the joint from the upper arm.
5. Unbolt and remove the upper arm at the 2 bolts holding the inner shaft to the frame, taking note of the number, size and position of the aligning shims.
6. Install the upper arm with the adjusting shims in the same position and the same number as they were before removal. Tighten the bolts to 71 ft. lbs. (96 Nm).
7. Install the upper ball joint to the arm and tighten the bolts to 23 ft. lbs. (31 Nm).
8. Install the wheel.
9. Lower the truck and bounce it several times to set the suspension. Tighten the upper control arm shaft bolts to 93 ft. lbs. (126 Nm).

4WD Truck and 4Runner

1. Raise the truck and support it on safety stands. Remove the wheels.
 2. Remove the torsion bar.
 3. Remove the cotter pin and nut and press the upper ball joint out of the steering knuckle.
 4. Remove the upper shock absorber mounting nut. Do not disconnect the lower end of the shock.
 5. Disconnect the intermediate shaft from the steering gear housing. Remove the 2 nuts and bolt and lift out the upper arm.
- To install:**
6. Install the upper arm and tighten the mounting bolts to 131 ft. lbs. (178 Nm).
 7. Connect the intermediate shaft to the steering gear housing.
 8. Install a new upper shock absorber nut. Tighten it to 18 ft. lbs. (25 Nm).
 9. Connect the upper ball joint to the steering knuckle and tighten the nut to 105 ft. lbs. (142 Nm). Install a new cotter pin.
 10. Install the torsion bar.
 11. Install the wheel(s) and lower the vehicle.

8 SUSPENSION AND STEERING



kg·cm (ft·lb, N·m) : Specified torque

◆ Non-reusable part

2WD truck front suspension components

12. Have the alignment checked and adjusted at a reputable repair facility.

Lower Control Arm

REMOVAL AND INSTALLATION

2WD Truck

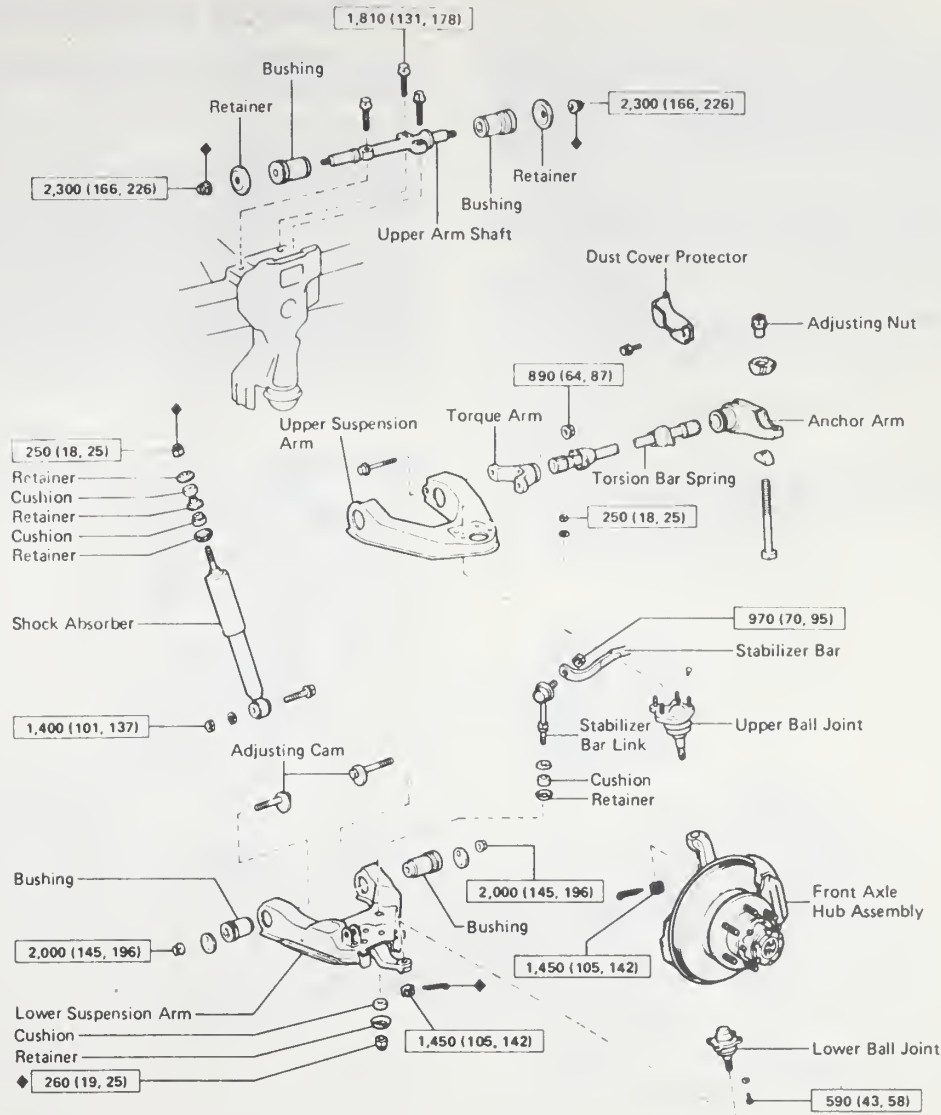
1. Raise the truck and support it on safety stands. Remove the wheels.
2. Remove the cotter pin and nut; use the correct tool to separate the tie rod end.
3. Remove the torsion bar spring.
4. Remove the shock absorber.
5. Disconnect the stabilizer bar from the lower arm.
6. Disconnect the strut bar from the lower arm.
7. Unbolt and remove lower ball joint.

8. Remove the lower suspension arm.

NOTE: If the lower ball joint is not to be replaced, simply unbolt it from the lower control arm. It is not necessary to separate the ball joint from the steering knuckle.

To install:

9. Install the torque arm bolts to the lower arm. Place the torque arm on the lower shaft.
10. Set the torque arm in its installation position, install the lower arm shaft and the torque arm. Finger tighten the lower arm bolts and then remove the torque arm. Do not tighten the nut much beyond snug.
11. Attach the lower ball joint to the suspension arm. Tighten the 3 bolts to 94 ft. lbs. (127 Nm).
12. Install the strut bar to the lower arm and connect the stabilizer bar to the arm.
13. Install the shock absorber. Tighten the lower mount to 13 ft. lbs. (18 Nm) and the upper mount to 18 ft. lbs. (25 Nm).



kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

4WD Truck and 4Runner front suspension components

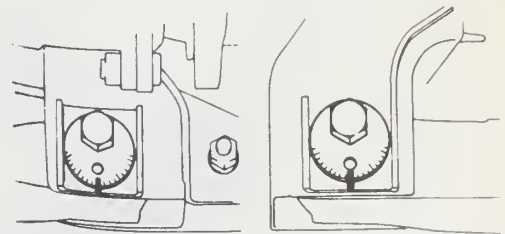
14. Connect the tie rod to the knuckle. Tighten the nut to 67 ft. lbs. (90 Nm). Install a new cotter pin to secure the nut.
15. Install the torsion bar.
16. Install the wheel(s) and lower the vehicle. Bounce the front end several times to stabilize the suspension.
17. Tighten the lower suspension nut to 166 ft. lbs. (226 Nm.)

CAUTION

Do not tighten the control arm bolt fully until the vehicle is lowered. If the bolts are tightened with the control arm(s) hanging, excessive bushing wear will result.

4WD Truck and 4Runner

1. Raise the front of the truck and support it with safety stands. Remove the wheels.
2. Remove the shock absorber.



Paint matchmarks on the adjusting cams before removing the lower control arm

3. Disconnect the stabilizer bar at the lower arm.
4. Disconnect the lower ball joint from the control arm.
5. Paint matchmarks on the front and rear adjusting cams, remove them and lift out the control arm.

8 SUSPENSION AND STEERING

To install:

6. Install the lower arm and adjusting cams to the frame. Temporarily tighten the nuts.
7. Connect the ball joint to the arm. Tighten the nut to 105 ft. lbs. (142 Nm) and install a new cotter pin.
8. Connect the stabilizer bar and tighten the nuts to 19 ft. lbs. (25 Nm).
9. Install the shock absorber.
10. Install the wheels and lower the truck. Bounce the truck several times to set the suspension.
11. Align the matchmarks on the adjusting cams and tighten the nuts to 145 ft. lbs. (196 Nm).
12. Have the alignment checked at a reputable repair facility.

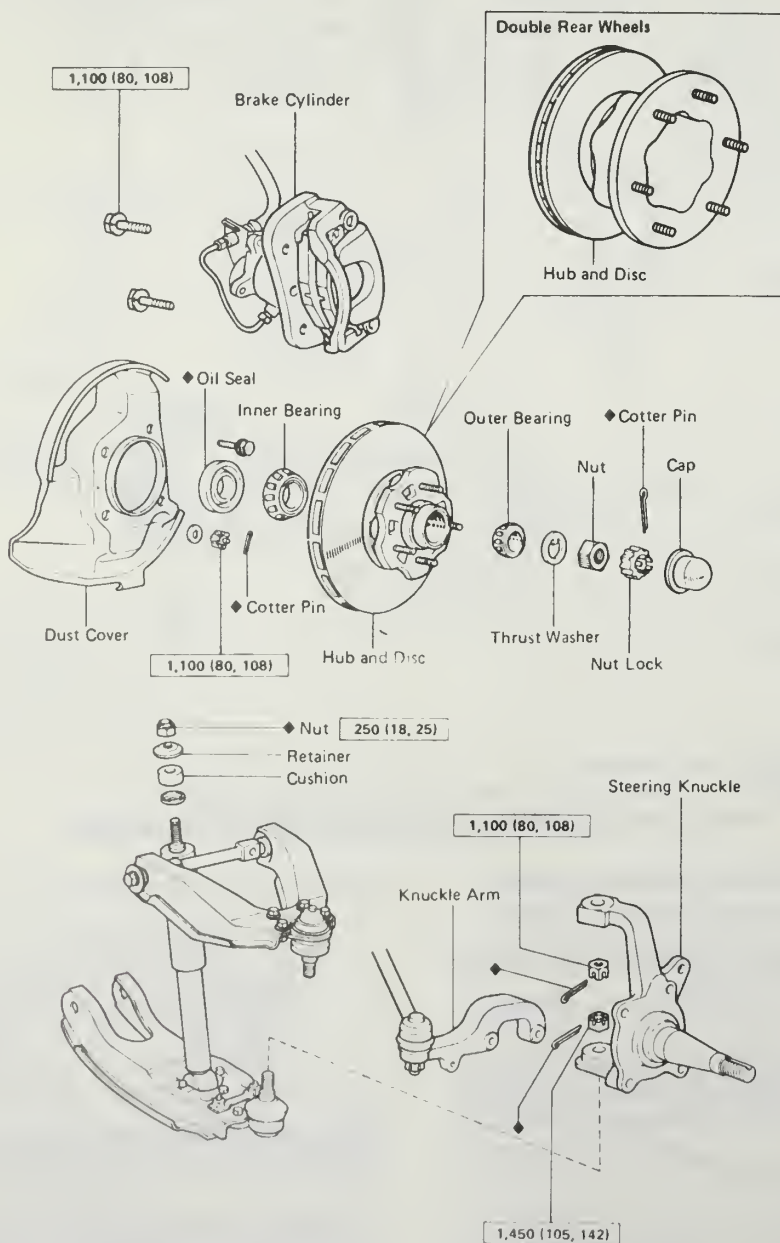
Steering Knuckle And Spindle REMOVAL AND INSTALLATION

2WD Trucks

1. Raise the front of the truck and support with safety stands. Remove the wheels.
2. Remove the brake caliper from the mount but do not disconnect the brake line. Use stiff wire to support the caliper out of the way. Remove the brake rotor and hub.

CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.



2WD truck front hub and steering knuckle

3. Remove the 2 cotter pins and bolts and remove the dust cover.
4. Disconnect the knuckle arm from the steering knuckle.
5. Position a floor jack under the lower control arm and disconnect the ball joints.
6. Remove the steering knuckle.

To install:

7. Install the steering knuckle into the 2 ball joints and tighten the upper nut to 80 ft. lbs. (108 Nm). Tighten the lower nut to 105 ft. lbs. (142 Nm). Install new cotter pins.
9. Install the knuckle arm and dust cover. Tighten the bolts to 80 ft. lbs. (108 Nm) and secure them with new cotter pins.
10. Install the brake disc and hub and install the brake caliper.
11. Install the wheels, lower the truck and check the alignment.

4WD Truck and 4Runner

1. Raise the front of the truck and support it on safety stands. Remove the wheels.
2. Remove the brake caliper. Remove the brake disc and front axle hub.

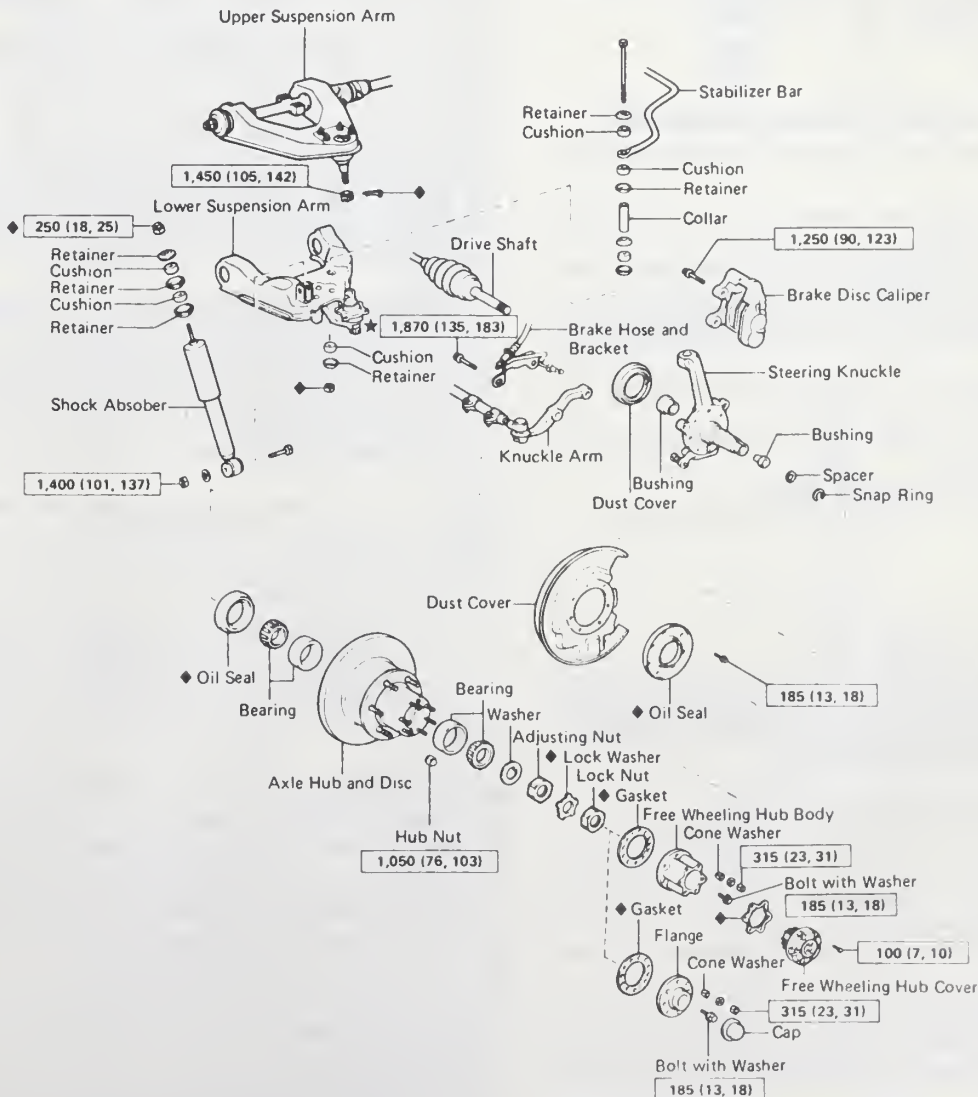
CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

3. Remove the dust cover (splash shield) and oil seal.
4. Disconnect the knuckle arm at the steering knuckle.
5. Disconnect the shock absorber at the lower control arm.
6. Disconnect the stabilizer bar at the lower control arm.
7. Remove the snapping and spacer from the end of the knuckle spindle.
8. Remove the cotter pin and nut from the upper ball joint. Use a ball joint separator to disconnect it from the knuckle.
9. Remove the 4 bolts and disconnect the lower ball joint from the knuckle.
10. Press down on the lower control arm and lift out the steering knuckle.

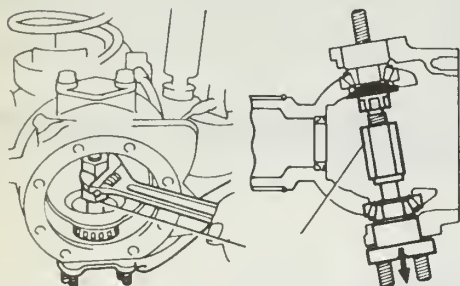
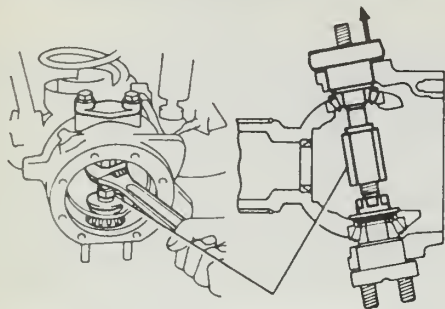
To install:

11. Coat the splines of the axle shaft with grease, press down on the lower control arm and slide the knuckle over the axle shaft and into position.



4WD truck and 4Runner front hub and steering knuckle

8 SUSPENSION AND STEERING



A special extractor is used to remove the knuckle arm and bearing caps from the Land Cruiser housing

12. Connect the lower ball joint to the knuckle and tighten the 4 bolts to 43 ft. lbs. (58 Nm).
13. Connect the upper ball joint to the knuckle and tighten the nut to 105 ft. lbs. (142 Nm). Install a new cotter pin.
14. Install the spacer and snapping to the end of the axle shaft.
15. Connect the stabilizer bar and the shock absorber to the lower arm.
16. Connect the knuckle arm to the steering knuckle and tighten the bolt to 135 ft. lbs. (183 Nm).
17. Install the dust cover with a new oil seal and tighten the bolt to 13 ft. lbs. (18 Nm).
18. Install the brake disc and brake caliper.
19. Install the wheels. Lower the vehicle to the ground.
20. Bleed the brakes.

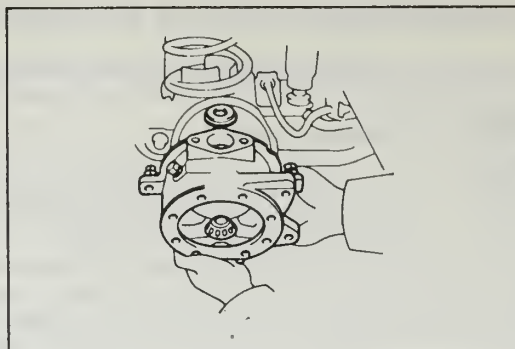
Land Cruiser

1. Remove the front axle hub.

CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

2. Remove the knuckle spindle mounting bolts.
3. Remove the dust seal and dust cover (splash shield).
4. Tap the knuckle spindle gently and remove it from the steering knuckle.
5. Turn the axle so that one flat part of the outer shaft faces upward; pull out the axle shaft.
6. Use a separator to disconnect the tie rod end from the knuckle arm.
7. Remove the oil seal and retainer.
8. Remove the knuckle arm bearing and bearing cap nuts. Lightly tap the slits of the washers and remove them. Push out the knuckle arm and shims from the steering knuckle. Don't lose the shims.
9. Remove the steering knuckle and bearing. Mark the removed adjusting shims and bearings by position for reassembly.



Installing the steering knuckle and bearings

To install:

10. Install a new oil seal if it was removed from the axle housing. Install a new oil seal set (felt dust seal, rubber seal and steel ring, in that order).
11. Place the bearings in position on the knuckle and axle housing. Place the knuckle onto the housing.
12. Support the upper bearing inner race on the knuckle arm. Install the arm over the shims, making sure the shims are in their exact original location. Tap the knuckle arm into the inner race.
13. Support the lower bearing inner race. Install the bearing cap over the shims, making sure the shims are in their exact original location. Tap the bearing cap into the inner race.
14. Remove the race supports. Install the cone washers to the third arm and tighten the nuts to 71 ft. lbs. (96 Nm). Install the cone washers to the knuckle arm and tighten the nuts to the same value.
15. Use a spring tension gauge to measure the bearing preload. Correct preload is 6.6–13.2 lbs. (19–59 N).
16. Connect the tie rod to the knuckle arm. Tighten the castle nut to 67 ft. lbs. (91 Nm). Install a new cotter pin.
17. Install the oil seal set to the knuckle.
18. Install the axle shaft.
19. Pack the knuckle about 3/4 full with moly disulphide grease.
20. Place a new gasket on the knuckle and install the spindle. Install the gasket, dust cover and dust seal on the spindle. Tighten the spindle mounting bolts to 34 ft. lbs. (47 Nm).
21. Install the axle hub.

Front Axle Hub and Bearing

REMOVAL AND INSTALLATION

2WD Truck

1. Raise the front of the truck and support with safety stands. Remove the wheels.
2. Remove the brake caliper and suspend it with wire, out of the way. Remove the caliper mount bracket (torque plate).

CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

3. Remove the axle end cap and then remove the cotter pin, nut lock and nut.
4. Pull the hub/disc assembly off the spindle with the outer bearing. Don't let the bearing fall out.
5. Pry the inner oil seal out and remove the inner bearing from the hub.

6. Clean the bearings and outer races and inspect them for wear or cracks.
7. Using a brass drift and a hammer, drive out the bearing outer race. Press a new one into position.
8. Pack the bearings with grease until it oozes out the other side. Coat the inside of the hub and cap with grease.
9. Position the inner bearing into the hub, coat the oil seal with grease and press it into the hub.
10. Press the hub assembly onto the spindle and install the outer bearing and thrust washer.
11. Install the hub nut and tighten it to 25 ft. lbs. (34 Nm). Turn the hub a few times to seat the bearings and then loosen the nut until there is 0.5mm play or less. Using a spring tension gauge, check that the preload is 1.3-4.0 lbs.
12. Install the locknut, new cotter pin and hub grease cap.
13. Install the brake torque plate to the knuckle. Install the brake caliper.
14. Install the wheels and lower the vehicle.

4WD Truck and 4Runner Land Cruiser

Hub and bearing removal and installation procedures for these models are given in Section 7.

Front End Alignment

Alignment of the front wheels is essential if your vehicle is to go, stop and turn as designed. Alignment can be altered by collision, overloading, poor repair or bent components.

If you are diagnosing bizarre handling and/or poor road manners, the first place to look is the tires. Although the tires may wear as a result of an alignment problem, worn or poorly inflated tires can make you chase alignment problems which don't exist.

Once you have eliminated all other causes, unload everything from the trunk except the spare tire, set the tire pressures to the correct level and take the car to a reputable alignment facility. Since the alignment settings are measured in very small increments, it is almost impossible for the owner/mechanic to accurately determine the settings. The explanations that follow will help you understand the three dimensions of alignment: caster, camber and toe.

CASTER

Caster is the tilting of the steering axis either forward or backward from the vertical, when viewed from the side of the vehicle. A backward tilt is said to be positive and a forward tilt is said to be negative. Changes in caster affect the straight line tendency of the vehicle and the "return to center" of the steering after a turn. If the camber is radically different between the left and right wheels (such as after hitting a major pothole), the car will exhibit a nasty pull to one side.

On the 2WD trucks, caster is adjustable through the use of shims which reposition the suspension components in the correct direction. 4WD Trucks and 4Runner allow adjustment by turning the adjusting cams to reposition the arms. Land Cruisers do not allow adjustment; replacement of bent components is required if the caster measurement is out of specification.

CAMBER

Camber is the tilting of the wheels from the vertical (leaning in or out) when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is said to be positive. When the wheels tilt inward at the top the camber is said to be negative. The amount of tilt is measured in degrees from the vertical. This measurement is called camber angle.

Camber affects the position of the tire on the road surface

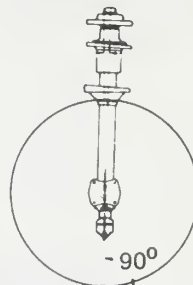
during vertical suspension movement and cornering. Changes in camber affect the handling and ride qualities of the car as well as tire wear. Many tire wear patterns indicate camber related problems from misalignment, overloading or poor driving habits.

Camber is adjustable on Trucks and 4Runners, either through the use of shims on the 2WD truck or by turning the adjusting cams on 4WD vehicles. Land Cruisers are not camber adjustable; if the measurement is out of specification, bent or damaged components must be replaced.

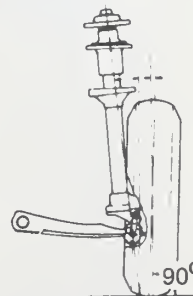
TOE

Toe is the turning in or out (parallelism) of the wheels. The actual amount of toe setting is normally only a fraction of an inch. The purpose of toe-in (or out) specification is to insure parallel rolling of the wheels. Toe-in also serves to offset the small deflections of the steering support system which occur when the vehicle is rolling forward or subjected to hard braking.

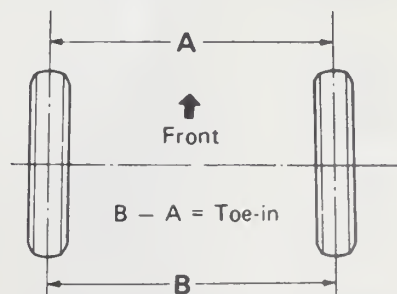
Changing the toe setting will radically affect the overall "feel" of the steering, the behavior of the car under braking, tire wear and even fuel economy. Excessive toe (in or out) causes excessive drag or scrubbing on the tires.



Caster is the forward or backward inclination of the steering axis



Camber is the inward or outward tilt of the wheel when viewed from the front of the vehicle



Toe (in or out) refers to the relative position of the wheels when viewed from above

8 SUSPENSION AND STEERING

Toe is adjustable on all Toyota Trucks, 4Runners and Land Cruisers. It is generally measured in decimal inches or degrees. It is adjusted by loosening the locknut on each tie rod end and

turning the rod until the correct reading is achieved. The rods left and right must remain equal in length during all adjustments.

ALIGNMENT CHART
1989 2WD Truck

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
	Inspection standard			
	Adjustment standard			
RN80L—TRKRSA(3)	0°28′ ± 45′	0°41′ ± 45′	10°01′ ± 45′	2 ± 2 (0.08 ± 0.08)
RN80L—TRTRSA(3)	0°28′ ± 30′	0°41′ ± 30′	—	2 ± 1 (0.08 ± 0.04)
RN80L—TRLDSA(3)	0°29′ ± 45′	0°44′ ± 45′	10°00′ ± 45′	1.5 ± 2 (0.059 ± 0.08)
RN80L—TRMRSK	0°29′ ± 30′	0°44′ ± 30′	—	1.5 ± 2 (0.059 ± 0.04)
RN85L—TRLDSA(3)	0°27′ ± 45′	0°59′ ± 45′	10°02′ ± 45′	2.4 ± 2 (0.094 ± 0.08)
RN85L—TRMDSK	0°27′ ± 30′	0°59′ ± 30′	—	2.4 ± 1 (0.094 ± 0.04)
RN90L—CRLDSA(3)	0°23′ ± 45′	1°09′ ± 45′	10°06′ ± 45′	3.6 ± 2 (0.142 ± 0.08)
RN90L—CRMDSK	0°23′ ± 30′	1°09′ ± 30′	—	3.6 ± 1 (0.142 ± 0.04)
RN80L—TRMDEA(3)	0°29′ ± 45′	0°45′ ± 45′	10°00′ ± 45′	1.5 ± 2 (0.059 ± 0.08)
	0°29′ ± 30′	0°45′ ± 30′	—	1.5 ± 1 (0.059 ± 0.04)
RN80L—TRSDEA(3)	0°29′ ± 45′	0°46′ ± 45′	10°00′ ± 45′	1.5 ± 2 (0.059 ± 0.08)
	0°29′ ± 30′	0°46′ ± 30′	—	1.5 ± 1 (0.059 ± 0.04)
RN85L—TRMDEA(3)	0°27′ ± 45′	1°00′ ± 45′	10°02′ ± 45′	2.4 ± 2 (0.094 ± 0.08)
	0°27′ ± 30′	1°00′ ± 30′	—	2.4 ± 1 (0.094 ± 0.04)
RN85L—TRSDEA(3)	0°27′ ± 45′	1°01′ ± 45′	10°02′ ± 45′	2.4 ± 2 (0.094 ± 0.08)
RN85L—TRSDEK	0°27′ ± 30′	1°01′ ± 30′	—	2.4 ± 1 (0.094 ± 0.04)
RN85L—TRMSEA(3)	0°21′ ± 45′	1°09′ ± 45′	10°08′ ± 45′	4 ± 2 (0.16 ± 0.08)
	0°21′ ± 30′	1°09′ ± 30′	—	4 ± 1 (0.16 ± 0.04)
RN85L—TRSSEA(3)	0°21′ ± 45′	1°10′ ± 45′	10°08′ ± 45′	4 ± 2 (0.16 ± 0.08)
	0°21′ ± 30′	1°10′ ± 30′	—	4 ± 1 (0.16 ± 0.04)
RN90L—CRMDEA(3)	0°22′ ± 45′	1°11′ ± 45′	10°07′ ± 45′	3.7 ± 2 (0.146 ± 0.08)
	0°22′ ± 30′	1°11′ ± 30′	—	3.7 ± 1 (0.146 ± 0.04)
RN90L—CRMSEA(3)	0°11′ ± 45′	1°23′ ± 45′	10°18′ ± 45′	6.1 ± 2 (0.240 ± 0.08)
	0°11′ ± 30′	1°23′ ± 30′	—	6.1 ± 1 (0.240 ± 0.04)
RN90L—CRSDEA(3)	0°22′ ± 45′	1°12′ ± 45′	10°07′ ± 45′	3.7 ± 2 (0.146 ± 0.08)
RN90L—CRSDEK	0°22′ ± 30′	1°12′ ± 30′	—	3.7 ± 1 (0.146 ± 0.04)
RN90L—CRSSEA(3)	0°11′ ± 45′	1°24′ ± 45′	10°18′ ± 45′	6.1 ± 2 (0.240 ± 0.08)
	0°11′ ± 30′	1°24′ ± 30′	—	6.1 ± 1 (0.240 ± 0.04)
VZN85L—TRMDEA(3)	0°28′ ± 45′	1°07′ ± 45′	10°01′ ± 45′	2 ± 2 (0.08 ± 0.08)
VZN85L—TRMDEK	0°28′ ± 30′	1°07′ ± 30′	—	2 ± 1 (0.08 ± 0.04)
VZN85L—TRSDEA(3)	0°28′ ± 45′	1°08′ ± 45′	10°01′ ± 45′	2 ± 2 (0.08 ± 0.08)
VZN85L—TRSDEK	0°28′ ± 30′	1°08′ ± 30′	—	2 ± 1 (0.08 ± 0.04)
VZN85L—THMDEA(3)	0°35′ ± 45′	0°34′ ± 45′	9°54′ ± 45′	5.4 ± 2 (0.213 ± 0.08)
	0°35′ ± 30′	0°34′ ± 30′	—	5.4 ± 1 (0.213 ± 0.04)
VZN85L—THSDEA(3)	0°35′ ± 45′	0°35′ ± 45′	9°54′ ± 45′	5.4 ± 2 (0.213 ± 0.08)
	0°35′ ± 30′	0°35′ ± 30′	—	5.4 ± 1 (0.213 ± 0.04)
VZN85L—TRMREA6	0°34′ ± 45′	0°04′ ± 45′	9°55′ ± 45′	5 ± 2 (0.20 ± 0.08)
	0°34′ ± 30′	0°04′ ± 30′	—	5 ± 1 (0.20 ± 0.04)
VZN85L—TRSREA6	0°34′ ± 45′	0°04′ ± 45′	9°55′ ± 45′	5 ± 2 (0.20 ± 0.08)
	0°34′ ± 30′	0°04′ ± 30′	—	5 ± 1 (0.20 ± 0.04)
VZN85L—TWMREA6	0°34′ ± 45′	0°05′ ± 45′	9°55′ ± 45′	4.9 ± 2 (0.193 ± 0.08)
	0°34′ ± 30′	0°05′ ± 30′	—	4.9 ± 1 (0.193 ± 0.04)
VZN85L—TWSREA6	0°34′ ± 45′	0°05′ ± 45′	9°55′ ± 45′	5 ± 2 (0.20 ± 0.08)
	0°34′ ± 30′	0°05′ ± 30′	—	5 ± 1 (0.20 ± 0.04)

ALIGNMENT CHART 1989 2WD Truck

Model		Camber	Caster	Steering axis inclination	Toe-in mm (in.)
				Inspection standard	
VZN90L—CRMDEA(3)	0°24′ ± 45′	1°16′ ± 45′	10°05′ ± 45′	3.2 ± 2 (0.126 ± 0.08)	
VZN90L—CRMDEK	0°24′ ± 30′	1°16′ ± 30′	—	3.2 ± 1 (0.126 ± 0.04)	
VZN90L—CRSDEA(3)	0°24′ ± 45′	1°17′ ± 45′	10°05′ ± 45′	3.2 ± 2 (0.126 ± 0.08)	
VZN90L—CRSDEK	0°24′ ± 30′	1°17′ ± 30′	—	3.2 ± 1 (0.126 ± 0.04)	
VZN90L—CRMGEA(3)	0°18′ ± 45′	1°25′ ± 45′	10°11′ ± 45′	4.8 ± 2 (0.189 ± 0.08)	
VZN90L—CRMGEK	0°18′ ± 30′	1°25′ ± 30′	—	4.8 ± 1 (0.189 ± 0.04)	
VZN90L—CRPGEA(3)	0°18′ ± 45′	1°26′ ± 45′	10°11′ ± 45′	4.7 ± 2 (0.185 ± 0.08)	
	0°18′ ± 30′	1°26′ ± 30′	—	4.7 ± 1 (0.185 ± 0.04)	
VZN95L—TWMREA6	0°34′ ± 45′	−0°09′ ± 45′	9°55′ ± 45′	4.9 ± 2 (0.193 ± 0.08)	
	0°34′ ± 30′	−0°09′ ± 30′	—	4.9 ± 1 (0.193 ± 0.04)	
VZN95L—TWSREA6	0°34′ ± 45′	−0°09′ ± 45′	9°55′ ± 45′	4.9 ± 2 (0.193 ± 0.08)	
VZN95L—TWSREK6	0°34′ ± 30′	−0°09′ ± 30′	—	4.9 ± 1 (0.193 ± 0.04)	
Wheel angle	Max.	Inside wheel	34° + 1°		
			−2°		
	At 20°	Outside wheel (outside wheel)	30° 22°15′ (inside wheel)		

ALIGNMENT CHART 1989 4WD Truck

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
	Inspection standard			
	Adjustment standard			
RN101L series	0°35' ± 45'	1°25' ± 45'	12°00' ± 45'	2 ± 2 (0.08 ± 0.08)
	0°35' ± 30'	1°25' ± 30'	—	2 ± 1 (0.08 ± 0.04)
RN106L series	0°35' ± 45'	1°30' ± 45'	12°00' ± 45'	3 ± 2 (0.12 ± 0.08)
	0°35' ± 30'	1°30' ± 30'	—	3 ± 1 (0.12 ± 0.04)
RN110L series	0°30' ± 45'	1°40' ± 45'	12°05' ± 45'	3 ± 2 (0.12 ± 0.08)
	0°30' ± 30'	1°40' ± 30'	—	3 ± 1 (0.12 ± 0.04)
VZN100L series	0°40' ± 45'	1°30' ± 45'	11°55' ± 45'	2 ± 2 (0.08 ± 0.08)
	0°40' ± 30'	1°30' ± 30'	—	2 ± 1 (0.08 ± 0.04)
VZN105L series	0°35' ± 45'	1°35' ± 45'	12°00' ± 45'	2 ± 2 (0.08 ± 0.08)
	0°35' ± 30'	1°35' ± 30'	—	2 ± 1 (0.08 ± 0.04)
VZN110L—CRMDEA(3)	0°35' ± 45'	1°40' ± 45'	12°00' ± 45'	3 ± 2 (0.12 ± 0.08)
VZN110L—CRMDEK	0°35' ± 30'	1°40' ± 30'	—	3 ± 1 (0.12 ± 0.04)
VZN110L—CRPDEA(3)				
VZN110L—CRMGEA(3)				
VZN110L—CRPGWA(3)	0°35' ± 45'	1°45' ± 45'	12°00' ± 45'	3 ± 2 (0.12 ± 0.08)
VZN110L—CRPDEK	0°35' ± 30'	1°45' ± 30'	—	3 ± 1 (0.12 ± 0.04)
VZN110L—CRMGEK				
Camber left-right error			30' or less	
Caster left-right error			30' or less	
Steering axis inclination left-right error			30' or less	
Wheel angle	Max.	Inside wheel	32°00' +1°	
			−2°	
		Outside wheel	31°	
	At 20°	(outside wheel)	21°10' (inside wheel)	

8 SUSPENSION AND STEERING

WHEEL ALIGNMENT CHART 1989 4 Runner

Front wheel alignment and chassis ground clearance	Model	Chassis Ground clearance mm (in.)		Toe-in mm (in.)	Camber	Caster	Steering axis Inclination		
		Front	Rear					Inspection standard	
								Adjustment standard	
RN61LG-MSEA	284.5 (11.201)	415.5 (16.358)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
RN61LG-PSEA	284.5 (11.201)	415.5 (16.358)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
RN61LG-MDEA	283.5 (11.161)	416.0 (16.378)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
RN61LG-PDEA	283.5 (11.161)	416.0 (16.378)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
RN61LV-MDEA	279.0 (10.984)	417.0 (16.417)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
RN61LV-PDEA	279.5 (11.004)	415.5 (16.358)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
VZN61LG-MSEA	281.5 (11.083)	413.0 (16.260)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°10' ± 45' 2°10' ± 30'	11°55' ± 45' —			
VZN61LG-PSEA	281.5 (11.083)	411.5 (16.201)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°10' ± 45' 2°10' ± 30'	11°55' ± 45' —			
VZN61LG-MDEA	284.5 (11.201)	415.5 (16.358)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
VZN61LG-PDEA	284.5 (11.201)	415.5 (16.358)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
RN61LV-MSEK	284.0 (11.181)	415.5 (16.358)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
RN61LV-MDEK	282.5 (11.122)	416.0 (16.378)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°05' ± 45' 2°05' ± 30'	11°55' ± 45' —			
RN61LV-PDEK	282.5 (11.122)	414.5 (16.319)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°10' ± 45' 2°10' ± 30'	11°55' ± 45' —			
VZN61LV-MSEK	281.0 (11.063)	413.0 (16.260)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°10' ± 45' 2°10' ± 30'	11°55' ± 45' —			
VZN61LV-PSEK	281.0 (11.063)	411.5 (16.201)	3±2 (0.12±0.08) 3±1 (0.12±0.04)	0°40' ± 45' 0°40' ± 30'	2°10' ± 45' 2°10' ± 30'	11°55' ± 45' —			
Camber left-right error				30' or less					
Caster left-right error				30' or less					
Steering axis inclination left-right error				30' or less					

ALIGNMENT CHART 1990 2WD Truck

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
	Inspection standard			
	Adjustment standard			
RN80L—TRTRSA	0°29' ± 45'	0°26' ± 45'	10°00' ± 45'	1.7 ± 2 (0.067 ± 0.08)
	0°29' ± 30'	0°26' ± 30'	—	1.7 ± 1 (0.067 ± 0.04)
RN80L—TRMRSK	0°29' ± 45'	0°37' ± 45'	10°00' ± 45'	1.7 ± 2 (0.067 ± 0.08)
	0°29' ± 30'	0°37' ± 30'	—	1.7 ± 1 (0.067 ± 0.04)

ALIGNMENT CHART
1990 2WD Truck

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
			Inspection standard	
			Adjustment standard	
RN80L—TRLDSA	0°30' ± 45'	0°40' ± 45'	9°59' ± 45'	1.3 ± 2 (0.051 ± 0.08)
	0°30' ± 30'	0°40' ± 30'	—	1.3 ± 1 (0.051 ± 0.04)
RN85L—TRMDSK	0°28' ± 45'	0°57' ± 45'	10°01' ± 45'	2.1 ± 2 (0.083 ± 0.08)
	0°28' ± 30'	0°57' ± 30'	—	2.1 ± 1 (0.083 ± 0.04)
RN85L—TRLDSA	0°28' ± 45'	0°57' ± 45'	10°01' ± 45'	2.1 ± 2 (0.083 ± 0.08)
	0°28' ± 30'	0°57' ± 30'	—	2.1 ± 1 (0.083 ± 0.04)
RN90L—CRLDSA	0°23' ± 45'	1°14' ± 45'	10°06' ± 45'	3.3 ± 2 (0.130 ± 0.08)
	0°23' ± 30'	1°14' ± 30'	—	3.3 ± 1 (0.130 ± 0.04)
RN80L—TRKREA	0°29' ± 45'	0°40' ± 45'	10°00' ± 45'	1.7 ± 2 (0.067 ± 0.08)
	0°29' ± 30'	0°40' ± 30'	—	1.7 ± 1 (0.067 ± 0.04)
RN80L—TRSDEA	0°30' ± 45'	0°43' ± 45'	9°59' ± 45'	1.3 ± 2 (0.051 ± 0.08)
	0°30' ± 30'	0°43' ± 30'	—	1.3 ± 1 (0.051 ± 0.04)
RN80L—TRMDEA	0°30' ± 45'	0°43' ± 45'	9°59' ± 45'	1.3 ± 2 (0.051 ± 0.08)
	0°30' ± 30'	0°43' ± 30'	—	1.3 ± 1 (0.051 ± 0.04)
RN85L—TRMDEA	0°28' ± 45'	0°57' ± 45'	10°01' ± 45'	2.1 ± 2 (0.083 ± 0.08)
	0°28' ± 30'	0°57' ± 30'	—	2.1 ± 1 (0.083 ± 0.04)
RN85L—TRSDEA	0°28' ± 45'	0°58' ± 45'	10°01' ± 45'	2.1 ± 2 (0.083 ± 0.08)
	0°28' ± 30'	0°58' ± 30'	—	2.1 ± 1 (0.083 ± 0.04)
RN85L—TRMSEA	0°22' ± 45'	1°06' ± 45'	10°07' ± 45'	3.6 ± 2 (0.142 ± 0.08)
	0°22' ± 30'	1°06' ± 30'	—	3.6 ± 1 (0.142 ± 0.04)
RN85L—TRSSEA	0°22' ± 45'	1°07' ± 45'	10°07' ± 45'	3.6 ± 2 (0.142 ± 0.08)
	0°22' ± 30'	1°07' ± 30'	—	3.6 ± 1 (0.142 ± 0.04)
RN90L—CRMDEA	0°23' ± 45'	1°14' ± 45'	10°06' ± 45'	3.3 ± 2 (0.130 ± 0.08)
	0°23' ± 30'	1°14' ± 30'	—	3.3 ± 1 (0.130 ± 0.04)
RN90L—CRMSEA	0°13' ± 45'	1°23' ± 45'	10°16' ± 45'	5.5 ± 2 (0.217 ± 0.08)
	0°13' ± 30'	1°23' ± 30'	—	5.5 ± 1 (0.217 ± 0.04)
RN90L—CRSDEA	0°23' ± 45'	1°14' ± 45'	10°06' ± 45'	3.3 ± 2 (0.130 ± 0.08)
	0°23' ± 30'	1°14' ± 30'	—	3.3 ± 1 (0.130 ± 0.04)
RN90L—CRSSEA	0°13' ± 45'	1°24' ± 45'	10°16' ± 45'	5.5 ± 2 (0.217 ± 0.08)
	0°13' ± 30'	1°24' ± 30'	—	5.5 ± 1 (0.217 ± 0.04)
VZN85L—TRMDEA	0°28' ± 45'	0°53' ± 45'	10°01' ± 45'	2.1 ± 2 (0.083 ± 0.08)
	0°28' ± 30'	0°53' ± 30'	—	2.1 ± 1 (0.083 ± 0.04)
VZN85L—TRSDEA	0°28' ± 45'	0°54' ± 45'	10°01' ± 45'	2.1 ± 2 (0.083 ± 0.08)
	0°28' ± 30'	0°54' ± 30'	—	2.1 ± 1 (0.083 ± 0.04)
VZN85L—THMDEA	0°30' ± 45'	0°32' ± 45'	9°59' ± 45'	4.9 ± 2 (0.193 ± 0.08)
	0°30' ± 30'	0°32' ± 30'	—	4.9 ± 2 (0.193 ± 0.04)
VZN85L—THSDEA	0°30' ± 45'	0°32' ± 45'	9°59' ± 45'	4.9 ± 2 (0.193 ± 0.08)
	0°30' ± 30'	0°32' ± 30'	—	4.9 ± 2 (0.193 ± 0.04)
VZN85L—TRMREA6	0°30' ± 45'	0°04' ± 45'	9°59' ± 45'	4.5 ± 2 (0.177 ± 0.08)
	0°30' ± 30'	0°04' ± 30'	—	4.5 ± 2 (0.177 ± 0.04)
VZN85L—TRSREA6	0°30' ± 45'	0°04' ± 45'	9°59' ± 45'	4.5 ± 2 (0.177 ± 0.08)
	0°30' ± 30'	0°04' ± 30'	—	4.5 ± 1 (0.177 ± 0.04)
VZN85L—TWMREA6	0°29' ± 45'	1°15' ± 45'	10°00' ± 45'	5.7 ± 2 (0.224 ± 0.08)
	0°29' ± 30'	1°15' ± 30'	—	5.7 ± 2 (0.224 ± 0.04)
VZN85L—TWSREA6	0°29' ± 45'	1°16' ± 45'	10°00' ± 45'	5.7 ± 2 (0.224 ± 0.08)
	0°29' ± 30'	0°16' ± 30'	—	5.7 ± 1 (0.224 ± 0.04)

8 SUSPENSION AND STEERING

ALIGNMENT CHART 1990 4WD Truck

Model		Camber	Caster	Steering axis inclination	Toe-in mm (in.)
		Inspection standard			
		Adjustment standard			
VZN90L—CRMDEA	0°25′ ± 45′	1°10′ ± 45′	10°04′ ± 45′	3.0 ± 2 (0.118 ± 0.08)	
VZN90L—CRMDEK	0°25′ ± 30′	1°10′ ± 30′	—	3.0 ± 1 (0.118 ± 0.04)	
VZN90L—CRSDEA	0°25′ ± 45′	1°11′ ± 45′	10°04′ ± 45′	3.0 ± 2 (0.118 ± 0.08)	
VZN90L—CRSDEK	0°25′ ± 30′	1°11′ ± 30′	—	3.0 ± 1 (0.118 ± 0.04)	
VZN90L—CRMGEA	0°26′ ± 45′	1°11′ ± 45′	10°03′ ± 45′	2.7 ± 2 (0.106 ± 0.08)	
VZN90L—CRMGEK	0°26′ ± 30′	1°11′ ± 30′	—	2.7 ± 1 (0.106 ± 0.04)	
VZN90L—CRPGEA	0°26′ ± 45′	1°11′ ± 45′	10°03′ ± 45′	2.7 ± 2 (0.106 ± 0.08)	
	0°26′ ± 30′	1°11′ ± 30′	—	2.7 ± 1 (0.106 ± 0.04)	
VZN95L—TWMREA6	0°29′ ± 45′	−0°01′ ± 45′	10°00′ ± 45′	6.0 ± 2 (0.236 ± 0.08)	
	0°29′ ± 30′	−0°01′ ± 30′	—	6.0 ± 1 (0.236 ± 0.04)	
VZN95L—TWSREA6	0°29′ ± 45′	−0°01′ ± 45′	10°00′ ± 45′	6.0 ± 2 (0.236 ± 0.08)	
VZN95L—TWSREK6	0°29′ ± 30′	−0°01′ ± 30′	—	6.0 ± 1 (0.236 ± 0.04)	
Wheel angle	Max.	Inside wheel	34° +1° −2°		
		Outside wheel	30°		
	At 20°	(outside wheel)	22°15′ (inside wheel)		

ALIGNMENT CHART 1990 4WD Truck

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
			Inspection standard	
			Adjustment standard	
RN101L series	0°35' ± 45'	1°25' ± 45'	12°00' ± 45'	2 ± 2 (0.08 ± 0.08)
	0°35' ± 30'	1°25' ± 30'	—	2 ± 1 (0.08 ± 0.04)
RN106L series	0°35' ± 45'	1°30' ± 45'	12°00' ± 45'	3 ± 2 (0.12 ± 0.08)
	0°35' ± 30'	1°30' ± 30'	—	3 ± 1 (0.12 ± 0.04)
RN110L series	0°30' ± 45'	1°40' ± 45'	12°05' ± 45'	3 ± 2 (0.12 ± 0.08)
	0°30' ± 30'	1°40' ± 30'	—	3 ± 1 (0.12 ± 0.04)
VZN100L series	0°40' ± 45'	1°30' ± 45'	11°55' ± 45'	2 ± 2 (0.08 ± 0.08)
	0°40' ± 30'	1°30' ± 30'	—	2 ± 1 (0.08 ± 0.04)
VZN105L series	0°35' ± 45'	1°35' ± 45'	12°00' ± 45'	2 ± 2 (0.08 ± 0.08)
	0°35' ± 30'	1°35' ± 30'	—	2 ± 1 (0.08 ± 0.04)
VZN110L—CRMDEA	0°35' ± 45'	1°40' ± 45'	12°00' ± 45'	3 ± 2 (0.12 ± 0.08)
VZN110L—CRMDEK	0°35' ± 30'	1°40' ± 30'	—	3 ± 1 (0.12 ± 0.04)
VZN110L—CRPDEA				
VZN110L—CRMGEA				
VZN110L—CRPGEA	0°35' ± 45'	1°45' ± 45'	12°00' ± 45'	3 ± 2 (0.12 ± 0.08)
VZN110L—CRPDEK	0°35' ± 30'	1°45' ± 30'	—	3 ± 1 (0.12 ± 0.04)
VZN110L—CRMGEK				
Camber left-right error			30' or less	
Caster left-right error			30' or less	
Steering axis inclination left-right error			30' or less	
Wheel angle	Max.	Inside wheel	32°00' +1° -2°	
		Outside wheel	31°	
	At 20°	(outside wheel)	21°10' (inside wheel)	

ALIGNMENT CHART 1991 2WD Truck

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
RN80L—TRSDEA RN80L—TRSDEK	0°30' ± 45'	0°43' ± 45'	10°00' ± 45'	1.32 ± 2 (0.0520 ± 0.08)
RN80L—TRMDEA RN80L—TRMDEK	0°30' ± 45'	0°44' ± 45'	10°00' ± 45'	1.32 ± 2 (0.0520 ± 0.08)
RN80L—TRMREA RN80L—TRMREK	0°28' ± 45'	0°40' ± 45'	10°01' ± 45'	1.74 ± 2 (0.0685 ± 0.08)
RN85L—TRMDEA RN85L—TRMDEK	0°27' ± 45'	0°59' ± 45'	10°02' ± 45'	2.09 ± 2 (0.0822 ± 0.08)
RN85L—TRSDEA RN85L—TRSDEK	0°27' ± 45'	0°58' ± 45'	10°02' ± 45'	2.09 ± 2 (0.0822 ± 0.08)
RN90L—CRSDEA RN90L—CRSDEK	0°23' ± 45'	1°15' ± 45'	10°06' ± 45'	3.27 ± 2 (0.1287 ± 0.08)
RN90L—CRMDEA RN90L—CRMDEK	0°23' ± 45'	1°15' ± 45'	10°06' ± 45'	3.27 ± 2 (0.1287 ± 0.08)
VZN85L—THMDEA	0°29' ± 45'	0°34' ± 45'	10°00' ± 45'	5.61 ± 2 (0.2209 ± 0.08)
VZN85L—THSDEA	0°30' ± 45'	0°33' ± 45'	10°00' ± 45'	4.85 ± 2 (0.1909 ± 0.08)
VZN85L—TWMREA6	0°29' ± 45'	1°46' ± 45'	10°00' ± 45'	5.73 ± 2 (0.2256 ± 0.08)
VZN85L—TWSREA6	0°29' ± 45'	1°45' ± 45'	10°00' ± 45'	5.73 ± 2 (0.2256 ± 0.08)
VZN90L—CRMDEA VZN90L—CRMDEK	0°23' ± 45'	1°11' ± 45'	10°06' ± 45'	3.27 ± 2 (0.1287 ± 0.08)
VZN90L—CRSDEA VZN90L—CRSDEK	0°23' ± 45'	1°12' ± 45'	10°06' ± 45'	3.27 ± 2 (0.1287 ± 0.08)
VZN90L—CRMGEA VZN90L—CRMGEK	0°25' ± 45'	1°13' ± 45'	10°04' ± 45'	2.82 ± 2 (0.1110 ± 0.08)
VZN90L—CRPGEA	0°25' ± 45'	1°12' ± 45'	10°04' ± 45'	2.82 ± 2 (0.1110 ± 0.08)
VZN95L—TWMREA6	0°29' ± 45'	1°47' ± 45'	10°00' ± 45'	5.73 ± 2 (0.2256 ± 0.08)
VZN95L—TWSREA6 VZN95L—TWSREK6	0°29' ± 45'	1°46' ± 45'	10°00' ± 45'	5.73 ± 2 (0.2256 ± 0.08)
Wheel angle	Max.	Inside wheel	34° +1° -2°	
	At 20°	Outside wheel (outside wheel)	30° 22°15' (inside wheel)	

ALIGNMENT CHART 1991 4WD Truck

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
RN106L series	0°42' ± 45'	1°41' ± 45'	11°53' ± 45'	2.22 ± 2 (0.0874 ± 0.08)
VZN100L series	0°43' ± 45'	1°41' ± 45'	11°52' ± 45'	1.91 ± 2 (0.0751 ± 0.08)
VZN105L series	0°42' ± 45'	1°45' ± 45'	11°53' ± 45'	2.22 ± 2 (0.0874 ± 0.08)
RN101L—TRMDEA	0°43' ± 45'	1°38' ± 45'	11°52' ± 45'	1.92 ± 2 (0.0756 ± 0.08)
RN101L—TRLDEA	0°43' ± 45'	1°38' ± 45'	11°52' ± 45'	1.92 ± 2 (0.0756 ± 0.08)
RN101L—TRLDEK	0°43' ± 45'	1°37' ± 45'	11°52' ± 45'	1.92 ± 2 (0.0756 ± 0.08)
RN101L—TRPDEA	0°43' ± 45'	1°41' ± 45'	11°52' ± 45'	1.91 ± 2 (0.0752 ± 0.08)
RN110L—CRMDEA	0°40' ± 45'	1°49' ± 45'	11°55' ± 45'	2.69 ± 2 (0.1059 ± 0.08)
RN110L—CRPDEA	0°40' ± 45'	1°52' ± 45'	11°55' ± 45'	2.69 ± 2 (0.1059 ± 0.08)

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ALIGNMENT CHART

1991 4WD Truck

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
RN110L—CRLDEA	0°40' ± 45'	1°49' ± 45'	11°55' ± 45'	2.68 ± 2 (0.1055 ± 0.08)
RN110L—CRLDEK	0°40' ± 45'	1°44' ± 45'	11°55' ± 45'	2.68 ± 2 (0.1055 ± 0.08)
VZN110L—CRMDEA	0°40' ± 45'	1°52' ± 45'	11°55' ± 45'	2.69 ± 2 (0.1059 ± 0.08)
VZN110L—CRMDEK	0°40' ± 45'	1°48' ± 45'	11°55' ± 45'	2.69 ± 2 (0.1059 ± 0.08)
VZN110L—CRPDEA	0°40' ± 45'	1°53' ± 45'	11°55' ± 45'	2.69 ± 2 (0.1059 ± 0.08)
VZN110L—CRPDEK	0°40' ± 45'	1°49' ± 45'	11°55' ± 45'	2.69 ± 2 (0.1059 ± 0.08)
VZN110L—CRMGEA	0°42' ± 45'	1°55' ± 45'	11°53' ± 45'	2.25 ± 2 (0.0886 ± 0.08)
VZN110L—CRMGEK	0°42' ± 45'	1°50' ± 45'	11°53' ± 45'	2.25 ± 2 (0.0886 ± 0.08)
VZN110L—CRPGEA	0°42' ± 45'	1°56' ± 45'	11°53' ± 45'	2.25 ± 2 (0.0886 ± 0.08)
Camber left-right error			30' or less	
Caster left-right error			30' or less	
Steering axis inclination left-right error			30' or less	
Wheel angle	Max.	Inside wheel	32°00'	+1° -2°
		Outside wheel	31°	
	At 20°	(outside wheel)	21°10'	(inside wheel)

ALIGNMENT CHART

1989-90 Land Cruiser

Camber			$1^{\circ} \pm 45'$
King pin inclination			$9^{\circ}30' \pm 45'$
Caster			$0^{\circ}50' \pm 45'$
Toe-in			Inspection STD
			Adjustment STD
			$1 \pm 2 \text{ mm}$ ($0.04 \pm 0.08 \text{ in.}$)
wheel angle	Max.	Inside wheel	$32^{\circ} +0^{\circ}$ -3°
		Outside wheel	30°
	at 20° (Outside wheel)	Inside wheel	21°
		Outside wheel	

ALIGNMENT CHART

1991 Land Cruiser

Camber	Inspection standard Left-right error	$1^{\circ} \pm 45'$ 30' or less
Steering axis inclination	Inspection standard Let-right error	$13^{\circ}30' \pm 45'$ 30' or less
Caster	Inspection standard P235/75R 15 31 × 10.50R 15 Left-right error	$3^{\circ}00' \pm 60'$ $0^{\circ}45' \pm 30'$ 30' or less

ALIGNMENT CHART 1991 Land Cruiser

Toe-in	Inspection STD		Adjustment STD	
	2 ± 2 mm (0.08 ± 0.08 in.)		1 ± 2 mm (0.04 ± 0.08 in.)	
Wheel angle	Max.		Inside wheel	35°00' +0° -3°
			Outside wheel	30°00'

ALIGNMENT CHART 1990 4-Runner

Model	1990 4-Runner		Steering axis inclination	Toe-in mm (in.)
	Camber	Caster		
	Inspection standard			
	Adjustment standard			
RN120L-GKPSEA	0°43' ± 45'	2°13' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°13' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN130L-GJMSEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN130L-GJLSEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN130L-GJPSEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN130L-GJMSEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN130L-GKLSEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN130L-GKPSEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
VZN120L-GKPGEA	0°43' ± 45'	2°13' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°13' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
VZN130L-GJMGEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
VZN130L-GJPGEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
VZN130L-GKMGEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
VZN130L-GKPGEA	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN121L-PKMSEK	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN121L-PKPSEK	0°43' ± 45'	2°14' ± 45'	11°52' ± 45'	2.0 ± 2 (0.079 ± 0.08)
	0°43' ± 30'	2°14' ± 30'	—	2.0 ± 1 (0.079 ± 0.04)
RN131L-RJMSEK	0°43' ± 45'	2°16' ± 45'	11°52' ± 45'	1.9 ± 2 (0.075 ± 0.08)
	0°43' ± 30'	2°16' ± 30'	—	1.9 ± 1 (0.075 ± 0.04)
RN131L-RJLSEK	0°43' ± 45'	2°16' ± 45'	11°52' ± 45'	1.9 ± 2 (0.075 ± 0.08)
	0°43' ± 30'	2°16' ± 30'	—	1.9 ± 1 (0.075 ± 0.04)
RN131L-RJPSEK	0°43' ± 45'	2°16' ± 45'	11°52' ± 45'	1.9 ± 2 (0.075 ± 0.08)
	0°43' ± 30'	2°16' ± 30'	—	1.9 ± 1 (0.075 ± 0.04)

8 SUSPENSION AND STEERING

**ALIGNMENT CHART
1990 4-Runner**

Model	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
			Inspection standard	
			Adjustment standard	
RN131L-RKMSEK	0°43' ± 45' 0°43' ± 30'	2°16' ± 45' 2°16' ± 30'	11°52' ± 45' —	1.9 ± 2 (0.075 ± 0.08) 1.9 ± 1 (0.075 ± 0.04)
RN131L-RKLSEK	0°43' ± 45' 0°43' ± 30'	2°16' ± 45' 2°16' ± 30'	11°52' ± 45' —	1.9 ± 2 (0.075 ± 0.08) 1.9 ± 1 (0.075 ± 0.04)
RN131L-RKPSEK	0°43' ± 45' 0°43' ± 30'	2°16' ± 45' 2°16' ± 30'	11°52' ± 45' —	1.9 ± 2 (0.075 ± 0.08) 1.9 ± 1 (0.075 ± 0.04)
RN131L-RJMGEK	0°43' ± 45' 0°43' ± 30'	2°16' ± 45' 2°16' ± 30'	11°52' ± 45' —	1.9 ± 2 (0.075 ± 0.08) 1.9 ± 1 (0.075 ± 0.04)
RN131L-RJPGEK	0°43' ± 45' 0°43' ± 30'	2°16' ± 45' 2°16' ± 30'	11°52' ± 45' —	1.9 ± 2 (0.075 ± 0.08) 1.9 ± 1 (0.075 ± 0.04)
RN131L-RKMGEK	0°43' ± 45' 0°43' ± 30'	2°16' ± 45' 2°16' ± 30'	11°52' ± 45' —	1.9 ± 2 (0.075 ± 0.08) 1.9 ± 1 (0.075 ± 0.04)
RN131L-RKPGEK	0°43' ± 45' 0°43' ± 30'	2°16' ± 45' 2°16' ± 30'	11°52' ± 45' —	1.9 ± 2 (0.075 ± 0.08) 1.9 ± 1 (0.075 ± 0.04)
Camber left-right error			30° or less	
Caster left-right error			30° or less	
Steering axis inclination left-right error			30° or less	
Wheel angle				
	Max.	Inside wheel	32°00' +1° -2°	
		Outside wheel	31°00'	
	At 20°	(outside wheel)	21°10' (inside wheel)	

**ALIGNMENT CHART
1991 4-Runner**

Model	Tire size	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
RN120L-GKPSEA	P225/75R15	0°43' ± 45'	1°54' ± 45'	11°52' ± 45'	2.00 ± 2 (0.0800 ± 0.08)
RN130L-GJMSEA	P225/75R15	0°43' ± 45'	1°59' ± 45'	11°52' ± 45'	2.05 ± 2 (0.0807 ± 0.08)
RN130L-GJLSEA	P225/75R15	0°43' ± 45'	1°59' ± 45'	11°52' ± 45'	2.05 ± 2 (0.0807 ± 0.08)
RN130L-GJPSEA	P225/75R15	0°43' ± 45'	1°59' ± 45'	11°52' ± 45'	2.05 ± 2 (0.0807 ± 0.08)
RN130L-GKMSEA	P225/75R15	0°43' ± 45'	2°01' ± 45'	11°52' ± 45'	2.05 ± 2 (0.0807 ± 0.08)
RN130L-GKLSEA	P225/75R15	0°43' ± 45'	2°01' ± 45'	11°52' ± 45'	2.06 ± 2 (0.0811 ± 0.08)
RN130L-GKPSEA	P225/75R15	0°43' ± 45'	2°01' ± 45'	11°52' ± 45'	2.06 ± 2 (0.0811 ± 0.08)
VZV120L-GKPGEA	P225/75R15	0°43' ± 45'	1°56' ± 45'	11°52' ± 45'	2.00 ± 2 (0.0800 ± 0.08)
VZV120L-GJMGEA	P225/75R15	0°43' ± 45'	1°49' ± 45'	11°52' ± 45'	2.00 ± 2 (0.0800 ± 0.08)
	31 × 10.5R15	0°43' ± 45'	1°51' ± 45'	11°52' ± 45'	1.94 ± 2 (0.0764 ± 0.08)
VZV130L-GJPGEA	P225/75R15	0°43' ± 45'	1°50' ± 45'	11°52' ± 45'	1.99 ± 2 (0.0763 ± 0.08)
	31 × 10.5R15	0°43' ± 45'	1°52' ± 45'	11°52' ± 45'	1.93 ± 2 (0.0760 ± 0.08)
VZV130L-GKMGEA	P225/75R15	0°43' ± 45'	1°41' ± 45'	11°52' ± 45'	1.99 ± 2 (0.0763 ± 0.08)
	31 × 10.5R15	0°43' ± 45'	1°43' ± 45'	11°52' ± 45'	1.93 ± 2 (0.0760 ± 0.08)
VZV130L-GKPGEA	P225/75R15	0°43' ± 45'	1°40' ± 45'	11°52' ± 45'	1.99 ± 2 (0.0763 ± 0.08)
	31 × 10.5R15	0°43' ± 45'	1°43' ± 45'	11°52' ± 45'	1.93 ± 2 (0.0760 ± 0.08)
RN121L-RKMSEK	P225/75R15	0°43' ± 45'	1°43' ± 45'	11°52' ± 45'	1.92 ± 2 (0.0756 ± 0.08)

ALIGNMENT CHART 1991 4-Runner

Model	Tire size	Camber	Caster	Steering axis inclination	Toe-in mm (in.)
RN121L-RKPSEK	P225/75R15	0°43' ± 45'	1°46' ± 45'	11°52' ± 45'	1.92 ± 2 (0.0756 ± 0.08)
RN131L-RJLSEK	P225/75R15	0°43' ± 45'	1°48' ± 45'	11°52' ± 45'	1.97 ± 2 (0.0776 ± 0.08)
RN131L-RJPSEK	P225/75R15	0°43' ± 45'	1°50' ± 45'	11°52' ± 45'	1.97 ± 2 (0.0776 ± 0.08)
RN131L-RKLSEK	P225/75R15	0°43' ± 45'	1°53' ± 45'	11°52' ± 45'	1.97 ± 2 (0.0776 ± 0.08)
RN131L-RKPSEK	P225/75R15	0°43' ± 45'	1°53' ± 45'	11°52' ± 45'	1.97 ± 2 (0.0776 ± 0.08)
VZV131L-RJMGEK	P225/75R15	0°43' ± 45'	1°37' ± 45'	11°52' ± 45'	1.92 ± 2 (0.0756 ± 0.08)
	31 × 10.5R15	0°43' ± 45'	1°41' ± 45'	11°52' ± 45'	1.87 ± 2 (0.0736 ± 0.08)
VZV131L-RJPGEK	P225/75R15	0°43' ± 45'	1°39' ± 45'	11°52' ± 45'	1.93 ± 2 (0.0760 ± 0.08)
	31 × 10.5R15	0°43' ± 45'	1°42' ± 45'	11°52' ± 45'	1.88 ± 2 (0.0740 ± 0.08)
VZV131L-RKMGEK	P225/75R15	0°43' ± 45'	1°37' ± 45'	11°52' ± 45'	1.92 ± 2 (0.0760 ± 0.08)
	31 × 10.5R15	0°43' ± 45'	1°40' ± 45'	11°52' ± 45'	1.87 ± 2 (0.0736 ± 0.08)
VZV131L-RKPGEK	P225/75R15	0°43' ± 45'	1°47' ± 45'	11°52' ± 45'	1.91 ± 2 (0.0752 ± 0.08)
	31 × 10.5R15	0°43' ± 45'	1°49' ± 45'	11°52' ± 45'	1.86 ± 2 (0.0732 ± 0.08)
Camber left-right error			30' or less		
Caster left-right error			30' or less		
Steering axis inclination left-right error			30° or less		
Wheel angle	Max.	Inside wheel	32°00' +1° -2°		
		Outside wheel	31°00'		
	At 20°	(outside wheel)	21°10' (inside wheel)		

REAR SUSPENSION

Leaf Springs

REMOVAL AND INSTALLATION

1. Loosen the rear wheel lug nuts.
2. Raise the rear of the vehicle. Support the frame and rear axle housing with stands.
3. Remove the lug nuts and the wheel.
4. Remove the cotter pin, nut, and washer from the lower end of the shock absorber.
5. On the Land Cruiser, perform the following:
 - a. Remove the cotter pins and nuts from the lower end of the stabilizer link.
 - b. Detach the link from the axle housing.
6. Detach the shock absorber from the spring seat.
7. Remove the parking brake cable clamp (except Land Cruiser).

NOTE: Remove the parking brake equalizer, if necessary.

8. Unfasten the U-bolt nuts and remove the spring seat assemblies.

9. Adjust the height of the rear axle housing so that the weight of the rear axle is removed from the rear springs.

10. Unfasten the spring shackle retaining nuts. Withdraw the spring shackle inner plate. Carefully pry out the spring shackle with a bar.

11. Remove the spring bracket pin from the front end of the spring hanger and remove the rubber bushing.

12. Remove the spring. Use care not to damage the hydraulic brake line or the parking brake cable.

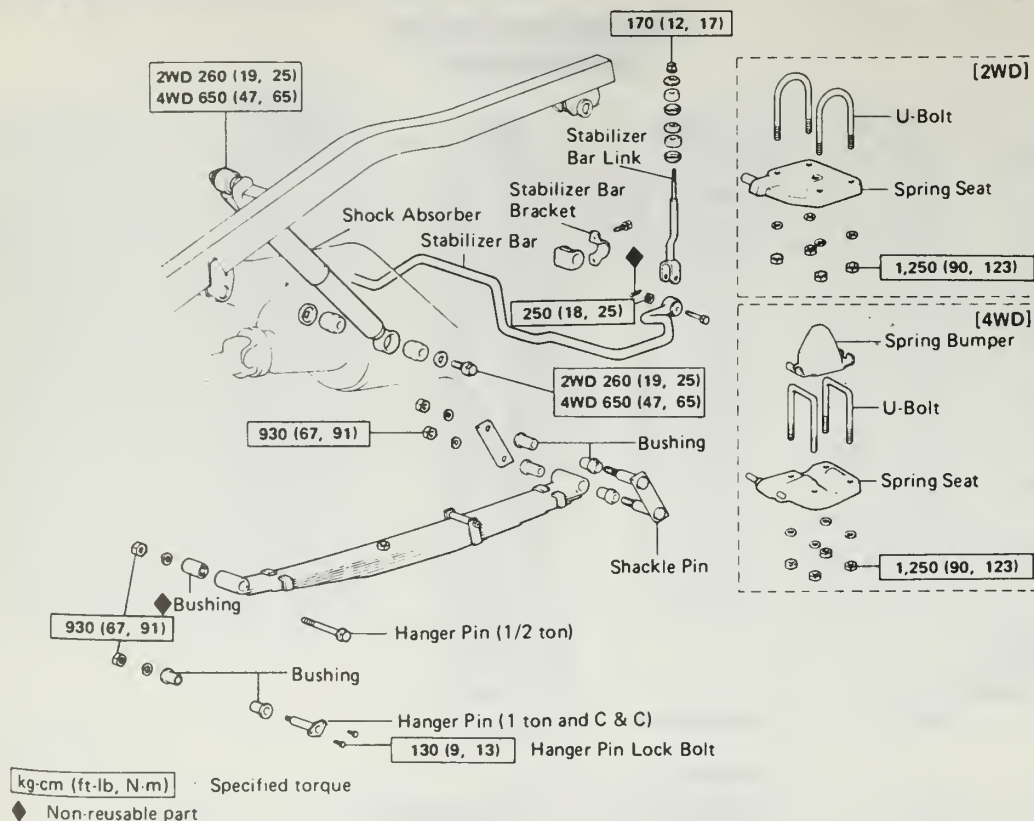
To install:

13. Install the rubber bushing in the eye of the spring.

14. Align the eye of the spring with the spring hanger bracket and drive the pin through the bracket holes and rubber bushings.

NOTE: Use soapy water or glass cleaner as a lubricant, if necessary, to aid in pin installation. Never use oil or grease.

8 SUSPENSION AND STEERING



Rear leaf springs — Truck and 4Runner

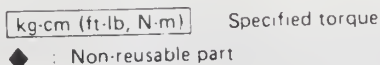
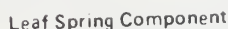
15. Finger-tighten the spring hanger nuts and/or bolts.
16. Install the rubber bushing in the spring eye at the opposite end of the spring.
17. Raise the free end of the spring. Install the spring shackle through the bushing and the bracket.
18. Install the shackle inner plate and finger-tighten the retaining nuts.
19. Center the bolt head in the hole which is provided in the spring seat on the axle housing.
20. Fit the U-bolts over the axle housing. Install the lower spring seat. Install the spring bumper on later 4WD models.
21. Tighten the U-bolt nuts to:
 - 2WD, ½ ton truck: 108 ft. lbs. (147 Nm)
 - 2WD, 1 ton truck or Cab and Chassis: 90 ft. lbs. (123 Nm).
 - 4WD, Xtra Cab: 90 ft. lbs. (123 Nm)
 - 4WD truck, all other models: 108 ft. lbs. (147 Nm)
 - 1989-90 Land Cruiser: 105 ft. lbs. (142 Nm).
22. Install the parking brake cable clamp. Install the equalizer, if it was removed.
23. Tighten the hanger pin and shackle nuts. Install the shock absorber bushings and washers. Tighten, and install the cotter pins.
24. Install the stabilizer link and hand tighten its retaining nuts.
25. Install the wheels, remove the stands, and lower the vehicle to the ground.
26. Bounce the truck several times to set the suspension and then tighten the shock absorber bolt. Tighten the hanger pin nut to 90 ft. lbs. (Land Cruiser) or 116 ft. lbs. for ½-ton trucks or 67 ft. lbs. for 1-ton trucks and C&C units. Tighten the shackle pin to 67 ft. lbs. (91 Nm) for all vehicles.

Coil Springs and Shock Absorber

REMOVAL AND INSTALLATION

4Runner and 1991 Land Cruiser

1. Elevate and safely support the vehicle on the frame rails. Place a floor jack under the rear axle housing and set the jack to hold the axle in place.
2. Remove the wheel(s).
3. Remove the lower shock absorber mount bolt. If the shock is to be replaced, disconnect the upper mount and remove the shock. If the shock is not to be removed, the upper mount may be left connected during spring removal. If only the shock is to be replaced (removal of the spring not required, skip to Step 13 for reinstallation. Refer to Inspection and/or Disposal of Shock Absorbers in the Front Suspension part of this Section.
4. Disconnect the stabilizer bar brackets from the rear axle housing.
5. On 4Runner, disconnect the right shock absorber lower mount.
6. Remove the bolt(s) holding the lateral control arm (Panhard rod) to the rear axle housing.
7. Very carefully begin to lower the jack holding the axle housing. Use extreme caution not to snap the brake lines and/or parking brake cable.
8. While lowering the axle, remove the coil spring as it loses tension and remove the upper insulators. Once the spring is removed, the bump stop (spring follower) may be unbolted from the frame if desired.



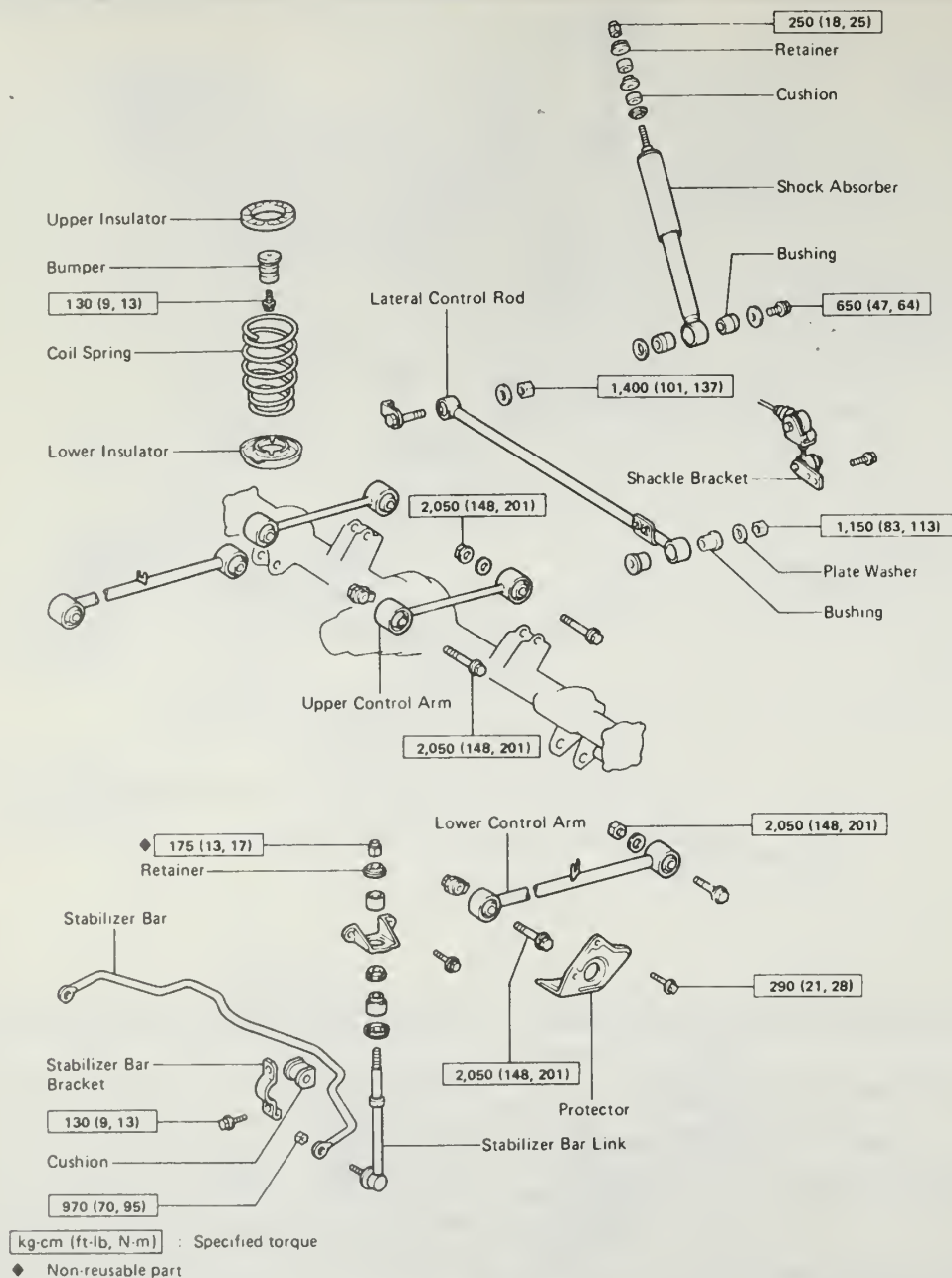
To install:

10. Install the coil spring and upper insulators. Check the end of the spring; it must be correctly installed against the stopper on the lower mount.

CAUTION

Do not compress the spring beyond the point reasonably necessary to hold it in place. Severe injury can occur if the spring comes loose.

8 SUSPENSION AND STEERING



4Runner rear suspension

12. Connect the lateral control rod to the axle housing, inserting the bolt from the front or shock absorber side. Install the nut but do NOT tighten it at this time.

13. Install the shock absorber. Tighten the upper mount (if it was loosened or removed) to 18 ft. lbs. (25 Nm) on 4Runner and 37 ft. lbs. (50 Nm) on Land Cruiser. Tighten the lower mount bolt to 47 ft. lbs. (64 Nm) on both vehicles.

14. Install the stabilizer bar to the axle housing.

15. Install the wheel(s) and lower the vehicle to the ground.

16. Bounce the rear of the vehicle several times to stabilize the suspension.

17. Use a floor jack to raise the rear axle housing (not the body of the vehicle) and support the axle with stands. Tighten the lat-

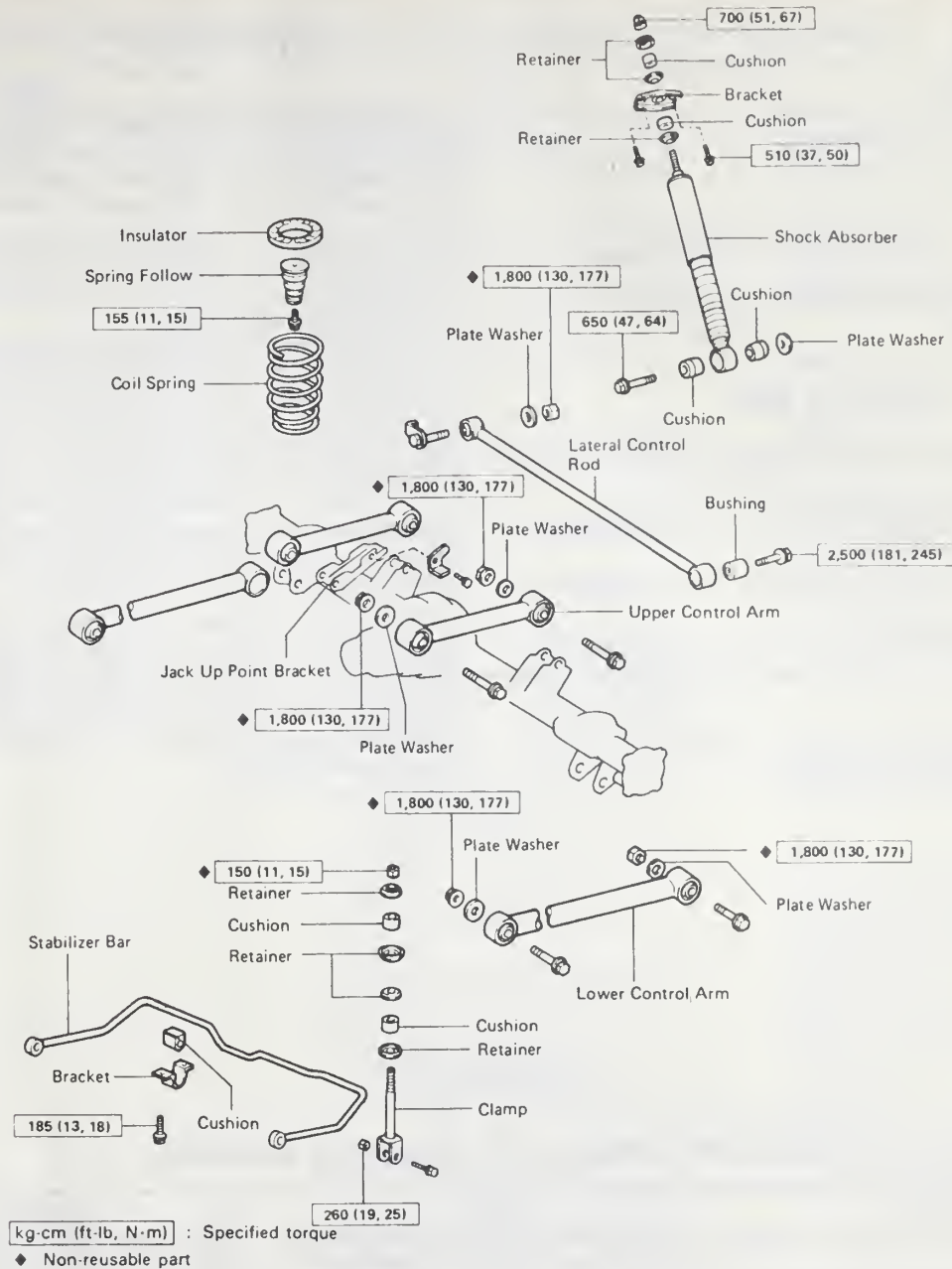
eral control rod nut to 101 ft. lbs. (137 Nm) on 4Runner or 130 ft. lbs. (177 Nm) on Land Cruisers.

18. Lower the vehicle to the ground.

Shock Absorbers Vehicles with Leaf Springs

REMOVAL AND INSTALLATION

1. Jack up the rear of the vehicle.
2. Support the rear axle housing with jackstands.



Land Cruiser rear suspension

3. Unfasten the upper shock absorber retaining nuts and/or bolts from the upper frame member.

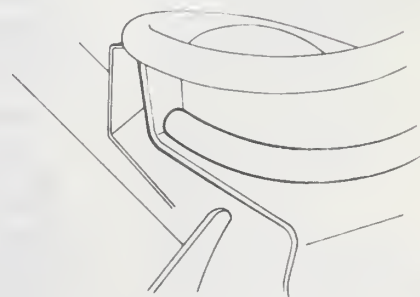
4. Depending upon the type of rear spring used, either disconnect the lower end of the shock absorber from the spring seat, or the rear axle housing, by removing its cotter pins, nuts and/or bolts.

5. Remove the shock absorber. Inspect the shock for wear, leaks, or other signs of damage. Refer to Inspection and/or Disposal of Shock Absorbers in the Front Suspension part of this Section.

6. Install the shock absorber and tighten the bolts to:
Land Cruiser: Upper mount, 47 ft. lbs. (64 Nm); Lower mount, 27 ft. lbs. (37 Nm).

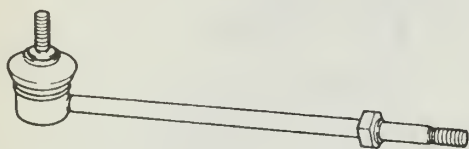
- 2WD Truck: Upper and Lower mounts, 19 ft. lbs. (25 Nm)
- 4WD Truck: Upper and Lower mounts, 53 ft. lbs. (72 Nm).

7. Lower the vehicle to the ground.



The spring end must be firmly against the lower mount

8 SUSPENSION AND STEERING



Always check the ball joints in the stabilizer bar connecting links

Stabilizer Bar

REMOVAL AND INSTALLATION

1. Raise the truck and support it with safety stands.
2. Disconnect the stabilizer bar link at the body. Remove the retainer and cushion from the link.
3. Disconnect the stabilizer bar bracket and cushion from the axle housing.
4. Remove the stabilizer bar.
5. Position the stabilizer bar at the axle housing and install the bracket and cushion. Tighten the mounting bolts to 8 ft. lbs. (11 Nm).
6. Install the link to the body with the retainers and cushion. Tighten the mounting bolts to 19 ft. lbs. (25 Nm).
7. Lower the vehicle to the ground.

Rear Wheel Alignment

The proper alignment of the rear wheels is as important as the alignment of the front wheels. The nature of the rear axles used on the vehicles covered in this book eliminates all possibility of adjusting the rear alignment specifications; correct alignment is achieved only by the correct installation of component parts.

In spite of this fact, a check of the rear alignment can reveal a hidden cause of rear tire wear or a cause of poor handling. If the rear wheels are mis-aligned, the vehicle will exhibit unpredictable handling characteristics.

The usual symptoms include a different turning responses into left and right corners and difficulty in maintaining a straight path. Both of these stem from the rear wheels attempting to steer the vehicle instead of rolling straight. This "rear steer" behavior is particularly hazardous on slick surfaces; the back wheels of the vehicle may attempt to go in directions unrelated to the front during braking or turning maneuvers.

NOTE: For a description of the alignment dimensions of **Caster, Camber and Toe**, please refer to the **Front Wheel Alignment** part of this Section.

The rear wheel alignment should be checked any time a problem is suspected or after any serious impact involving the rear wheels. Even a low-speed encounter with a curb on a snowy day can bend an axle. If the rear alignment check reveals a component problem, the timely inspection has saved you at least the cost of new tires and possibly a more serious accident by eliminating poor handling.

STEERING

Troubleshooting the Steering Column

Problem	Cause	Solution
Will not lock	• Lockbolt spring broken or defective	• Replace lock bolt spring
High effort (required to turn ignition key and lock cylinder)	• Lock cylinder defective	• Replace lock cylinder
	• Ignition switch defective	• Replace ignition switch
	• Rack preload spring broken or deformed	• Replace preload spring
	• Burr on lock sector, lock rack, housing, support or remote rod coupling	• Remove burr
	• Bent sector shaft	• Replace shaft
	• Defective lock rack	• Replace lock rack
	• Remote rod bent, deformed	• Replace rod
	• Ignition switch mounting bracket bent	• Straighten or replace
	• Distorted coupling slot in lock rack (tilt column)	• Replace lock rack

Troubleshooting the Steering Column (cont.)

Problem	Cause	Solution
Will stick in "start"	• Remote rod deformed • Ignition switch mounting bracket bent	• Straighten or replace • Straighten or replace
Key cannot be removed in "off-lock"	• Ignition switch is not adjusted correctly • Defective lock cylinder	• Adjust switch • Replace lock cylinder
Lock cylinder can be removed without depressing retainer	• Lock cylinder with defective retainer • Burr over retainer slot in housing cover or on cylinder retainer	• Replace lock cylinder • Remove burr
High effort on lock cylinder between "off" and "off-lock"	• Distorted lock rack • Burr on tang of shift gate (automatic column) • Gearshift linkage not adjusted	• Replace lock rack • Remove burr • Adjust linkage
Noise in column	• One click when in "off-lock" position and the steering wheel is moved (all except automatic column) • Coupling bolts not tightened • Lack of grease on bearings or bearing surfaces • Upper shaft bearing worn or broken • Lower shaft bearing worn or broken • Column not correctly aligned • Coupling pulled apart • Broken coupling lower joint • Steering shaft snap ring not seated • Shroud loose on shift bowl. Housing loose on jacket—will be noticed with ignition in "off-lock" and when torque is applied to steering wheel.	• Normal—lock bolt is seating • Tighten pinch bolts • Lubricate with chassis grease • Replace bearing assembly • Replace bearing. Check shaft and replace if scored. • Align column • Replace coupling • Repair or replace joint and align column • Replace ring. Check for proper seating in groove. • Position shroud over lugs on shift bowl. Tighten mounting screws.
High steering shaft effort	• Column misaligned • Defective upper or lower bearing • Tight steering shaft universal joint • Flash on I.D. of shift tube at plastic joint (tilt column only) • Upper or lower bearing seized	• Align column • Replace as required • Repair or replace • Replace shift tube • Replace bearings
Lash in mounted column assembly	• Column mounting bracket bolts loose • Broken weld nuts on column jacket • Column capsule bracket sheared	• Tighten bolts • Replace column jacket • Replace bracket assembly

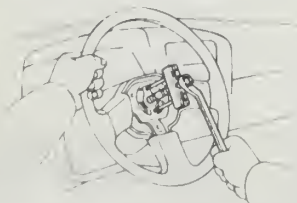
8 SUSPENSION AND STEERING

Troubleshooting the Steering Column (cont.)

Problem	Cause	Solution
Lash in mounted column assembly (cont.)	• Column bracket to column jacket mounting bolts loose • Loose lock shoes in housing (tilt column only) • Loose pivot pins (tilt column only) • Loose lock shoe pin (tilt column only) • Loose support screws (tilt column only)	• Tighten to specified torque • Replace shoes • Replace pivot pins and support • Replace pin and housing • Tighten screws
Housing loose (tilt column only)	• Excessive clearance between holes in support or housing and pivot pin diameters • Housing support-screws loose	• Replace pivot pins and support • Tighten screws
Steering wheel loose—every other tilt position (tilt column only)	• Loose fit between lock shoe and lock shoe pivot pin	• Replace lock shoes and pivot pin
Steering column not locking in any tilt position (tilt column only)	• Lock shoe seized on pivot pin • Lock shoe grooves have burrs or are filled with foreign material • Lock shoe springs weak or broken	• Replace lock shoes and pin • Clean or replace lock shoes • Replace springs
Noise when tilting column (tilt column only)	• Upper tilt bumpers worn • Tilt spring rubbing in housing	• Replace tilt bumper • Lubricate with chassis grease
One click when in "off-lock" position and the steering wheel is moved	• Seating of lock bolt	• None. Click is normal characteristic sound produced by lock bolt as it seats.
High shift effort (automatic and tilt column only)	• Column not correctly aligned • Lower bearing not aligned correctly • Lack of grease on seal or lower bearing areas	• Align column • Assemble correctly • Lubricate with chassis grease
Improper transmission shifting—automatic and tilt column only	• Sheared shift tube joint • Improper transmission gearshift linkage adjustment • Loose lower shift lever	• Replace shift tube • Adjust linkage • Replace shift tube

Steering Wheel REMOVAL AND INSTALLATION

WARNING: Do not attempt to remove or install the steering wheel by hammering on it. Damage to the energy absorbing steering column could result. Always use a steering wheel puller to extract the wheel from the shaft.



Avoid damage to other components — use a wheel puller

1. Position the wheels in the straight ahead position.
 2. Remove the steering wheel center pad. Check the back of the steering wheel spokes for recessed screws holding the pad and remove them if present. If no screws are found, the pad should snap out with firm finger pressure.
 3. Remove the steering wheel retaining nut.
 4. Scribe matchmarks on the hub and the steering shaft to aid in proper installation.
 5. Use the puller to extract the wheel from the shaft. Disconnect any wiring connectors running to the wheel once it is loose.
- To install:**
6. Align the matchmarks on the wheel hub and shaft. Connect any wiring connectors to the wheel and make certain the wiring is positioned correctly. Install the wheel onto the shaft.
 7. Install the center nut and tighten it to 25 ft. lbs. (34 Nm).
 8. Install the center pad, making sure it is correctly secured.
 9. Test drive the vehicle, checking for correct steering wheel alignment and horn function.

Troubleshooting the Ignition Switch

Problem	Cause	Solution
Ignition switch electrically inoperative	• Loose or defective switch connector • Feed wire open (fusible link) • Defective ignition switch	• Tighten or replace connector • Repair or replace • Replace ignition switch
Engine will not crank	• Ignition switch not adjusted properly	• Adjust switch
Ignition switch will not actuate mechanically	• Defective ignition switch • Defective lock sector • Defective remote rod	• Replace switch • Replace lock sector • Replace remote rod
Ignition switch cannot be adjusted correctly	• Remote rod deformed	• Repair, straighten or replace

Troubleshooting the Turn Signal Switch

Problem	Cause	Solution
Turn signal will not cancel	• Loose switch mounting screws • Switch or anchor bosses broken • Broken, missing or out of position detent, or cancelling spring	• Tighten screws • Replace switch • Reposition springs or replace switch as required
Turn signal difficult to operate	• Turn signal lever loose • Switch yoke broken or distorted • Loose or misplaced springs • Foreign parts and/or materials in switch • Switch mounted loosely	• Tighten mounting screws • Replace switch • Reposition springs or replace switch • Remove foreign parts and/or material • Tighten mounting screws
Turn signal will not indicate lane change	• Broken lane change pressure pad or spring hanger • Broken, missing or misplaced lane change spring • Jammed wires	• Replace switch • Replace or reposition as required • Loosen mounting screws, reposition wires and retighten screws
Turn signal will not stay in turn position	• Foreign material or loose parts impeding movement of switch yoke • Defective switch	• Remove material and/or parts • Replace switch
Hazard switch cannot be pulled out	• Foreign material between hazard support cancelling leg and yoke	• Remove foreign material. No foreign material impeding function of hazard switch—replace turn signal switch.

8 SUSPENSION AND STEERING

Troubleshooting the Turn Signal Switch (cont.)

Problem	Cause	Solution
No turn signal lights	• Inoperative turn signal flasher • Defective or blown fuse • Loose chassis to column harness connector • Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand. If vehicle lights now operate normally, signal switch is inoperative • If vehicle lights do not operate, check chassis wiring for opens, grounds, etc.	• Replace turn signal flasher • Replace fuse • Connect securely • Replace signal switch • Repair chassis wiring as required
Instrument panel turn indicator lights on but not flashing	• Burned out or damaged front or rear turn signal bulb • If vehicle lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc. • Inoperative flasher • Loose chassis to column harness connection • Inoperative turn signal switch • To determine if turn signal switch is defective, substitute new switch into circuit and operate switch by hand. If the vehicle's lights operate normally, signal switch is inoperative.	• Replace bulb • Repair chassis wiring as required • Replace flasher • Connect securely • Replace turn signal switch • Replace turn signal switch
Stop light not on when turn indicated	• Loose column to chassis connection • Disconnect column to chassis connector. Connect new switch into system without removing old.	• Connect securely • Replace signal switch
Stop light not on when turn indicated (cont.)	Operate switch by hand. If brake lights work with switch in the turn position, signal switch is defective. • If brake lights do not work, check connector to stop light sockets for grounds, opens, etc.	• Repair connector to stop light circuits using service manual as guide
Turn indicator panel lights not flashing	• Burned out bulbs • High resistance to ground at bulb socket • Opens, ground in wiring harness from front turn signal bulb socket to indicator lights	• Replace bulbs • Replace socket • Locate and repair as required

Troubleshooting the Turn Signal Switch (cont.)

Problem	Cause	Solution
Turn signal lights flash very slowly	• High resistance ground at light sockets • Incorrect capacity turn signal flasher or bulb • If flashing rate is still extremely slow, check chassis wiring harness from the connector to light sockets for high resistance • Loose chassis to column harness connection • Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If flashing occurs at normal rate, the signal switch is defective.	• Repair high resistance grounds at light sockets • Replace turn signal flasher or bulb • Locate and repair as required • Connect securely • Replace turn signal switch
Hazard signal lights will not flash—turn signal functions normally	• Blow fuse • Inoperative hazard warning flasher • Loose chassis-to-column harness connection • Disconnect column to chassis connector. Connect new switch into system without removing old. Depress the hazard warning lights. If they now work normally, turn signal switch is defective. • If lights do not flash, check wiring harness "K" lead for open between hazard flasher and connector. If open, fuse block is defective	• Replace fuse • Replace hazard warning flasher in fuse panel • Connect securely • Replace turn signal switch • Repair or replace brown wire or connector as required

Combination Switch

Removal and installation of the combination switch is covered in Section 6.

Ignition Switch

REMOVAL AND INSTALLATION

Both the electrical portion of the ignition switch and the key/lock portion may be replaced without removing the housing or bracket holding them. The bracket holding the ignition switch assembly is held to the column by bolts whose heads were intentionally broken off at installation. About the only time the bracket must be removed would be if the steering column or tube must be replaced. In the event that the bracket must be removed, the headless bolts must be center-punched, drilled and removed with a screw extracting tool.

1. Turn the ignition OFF and remove the key from the ignition.

2. Remove the steering wheel pad and remove the steering wheel.

3. Remove the upper and lower steering column covers. Remove the combination switch.

4. Disconnect the ignition wiring harness connector.

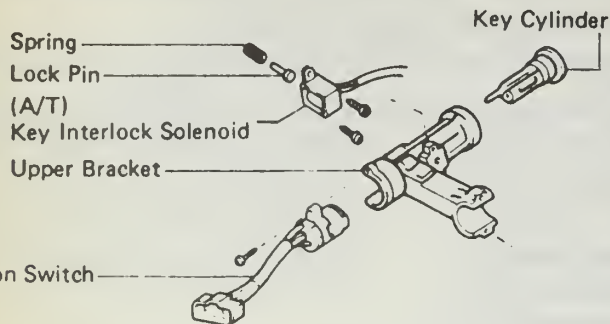
5. If only the electrical switch needs replacement, remove the retaining screw at the back of the lock housing and remove the switch. If the automatic transmission interlock relay must be changed, it may be unbolted from the housing—don't lose the spring and lock pin.

6. If the key lock assembly is to be changed, place the key in the switch and turn the key to the ACC position. Insert a thin rod in the hole at the bottom of the housing and press the stop tab inward. While holding the tab in, pull the cylinder out of the housing.

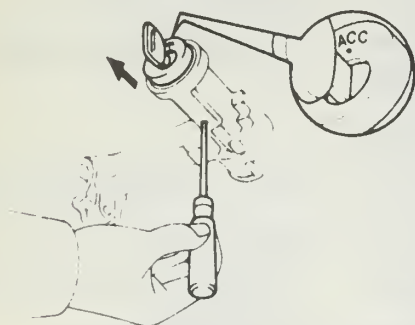
To install:

7. Install the new lock cylinder if necessary, making certain the key is in the ACC position before installation. Insert the cylinder and be sure the stop tab engages the hole. Once installed, turn the switch OFF and remove the key.

8 SUSPENSION AND STEERING



Ignition switch assembly



Removing the lock cylinder

8. Align the electrical switch with the back of the key cylinder. Install the retaining screw.
9. Connect the wiring harness connector. Make certain the harness is correctly routed and held by its clamps and clips.
10. Install the combination switch.
11. Install the steering wheel. Install the upper and lower steering column covers.
12. Operate the ignition switch in all positions, checking for correct function and lack of binding.

Steering Column

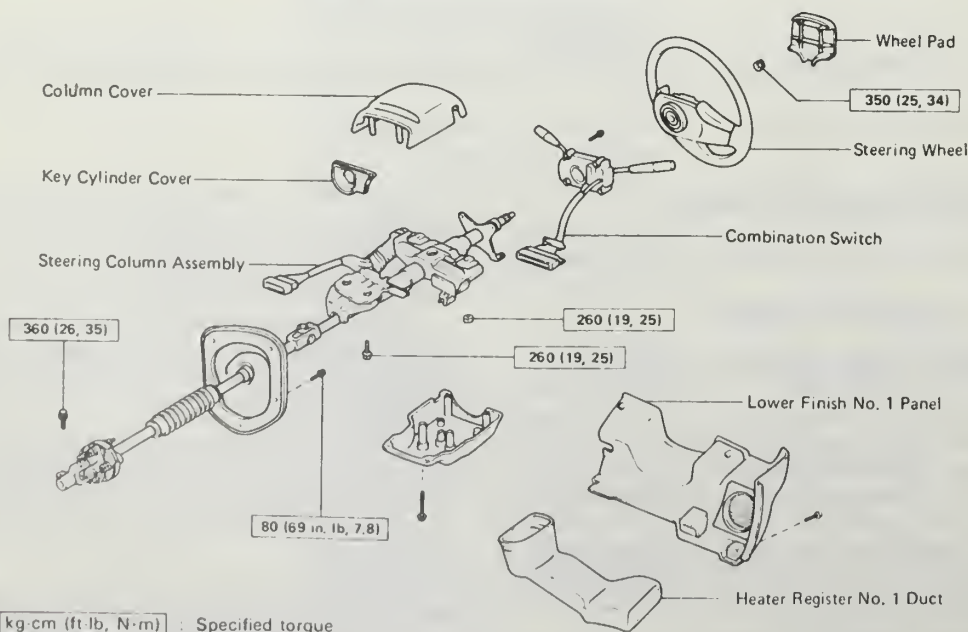
REMOVAL AND INSTALLATION

Truck and 4Runner 1991 Land Cruiser

1. Disconnect the negative battery cable.
2. Remove the steering wheel.
3. Remove the lower left side dash trim panel. Remove the heater duct (No. 1) from below the dash.
4. Remove the upper and lower steering column covers.
5. Disconnect the wiring connectors for the combination switch and the ignition switch.
6. Remove the combination switch.
7. Below the vehicle, at the steering gearbox, make matchmarks on the steering mainshaft and the worm shaft entering the gearbox. On trucks and 4Runners, loosen or remove the pinchbolt holding the main shaft to the worm shaft. On Land Cruiser, disconnect the bolts holding the coupling to the worm gear and to the shaft.
8. Inside the vehicle, remove the bolts holding the rubber steering hole cover to the floorboard.
9. Remove one of the two bolts holding the steering column to the instrument panel subframe. Remove the nut(s) holding the column.
10. Have an assistant support the steering column inside the vehicle before removing the other mounting bolt. The column is heavy and will come down heavily on you if not supported.
11. Pull the assembly into the vehicle, disconnecting the main shaft from the steering gearbox. Remove the steering column from the vehicle.

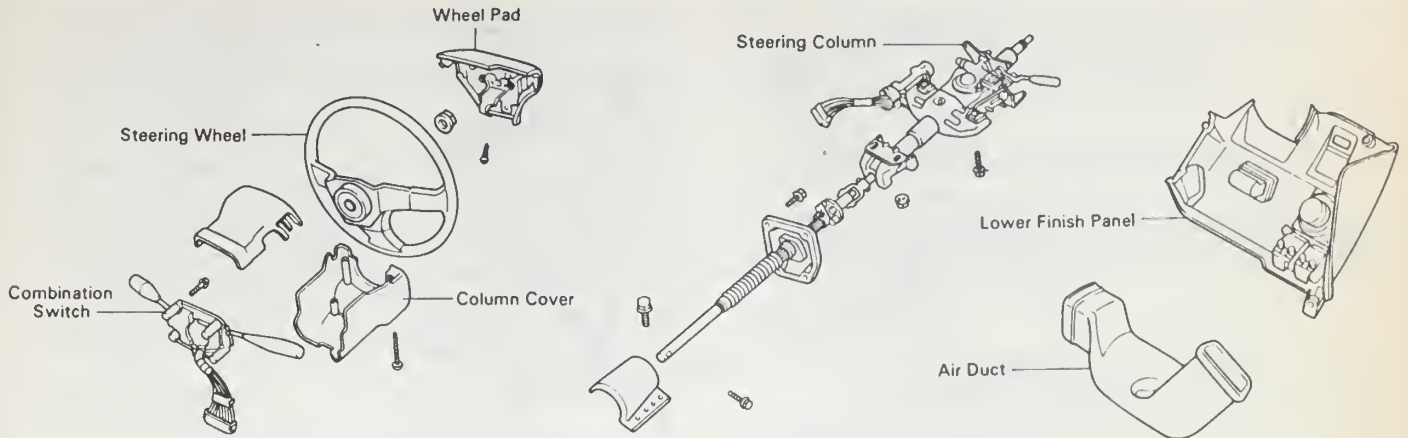
To install:

12. Place the column assembly into the vehicle and fit the main shaft through the floor hole.
13. Under the vehicle, align the matchmarks and fit the shaft onto the worm gear. Make certain the marks align exactly. For trucks and 4Runner, install the pinch bolt and tighten it to 26 ft. lbs. (35 Nm). For Land Cruiser, install the 2 bolts and tighten them to 25 ft. lbs. (34 Nm).
14. In the cab, lift the column into position and install the retaining bolts, tightening them to 19 ft. lbs. (25 Nm).



kg-cm (ft-lb, N-m) : Specified torque

Truck and 4Runner steering column



1991 Land Cruiser steering column

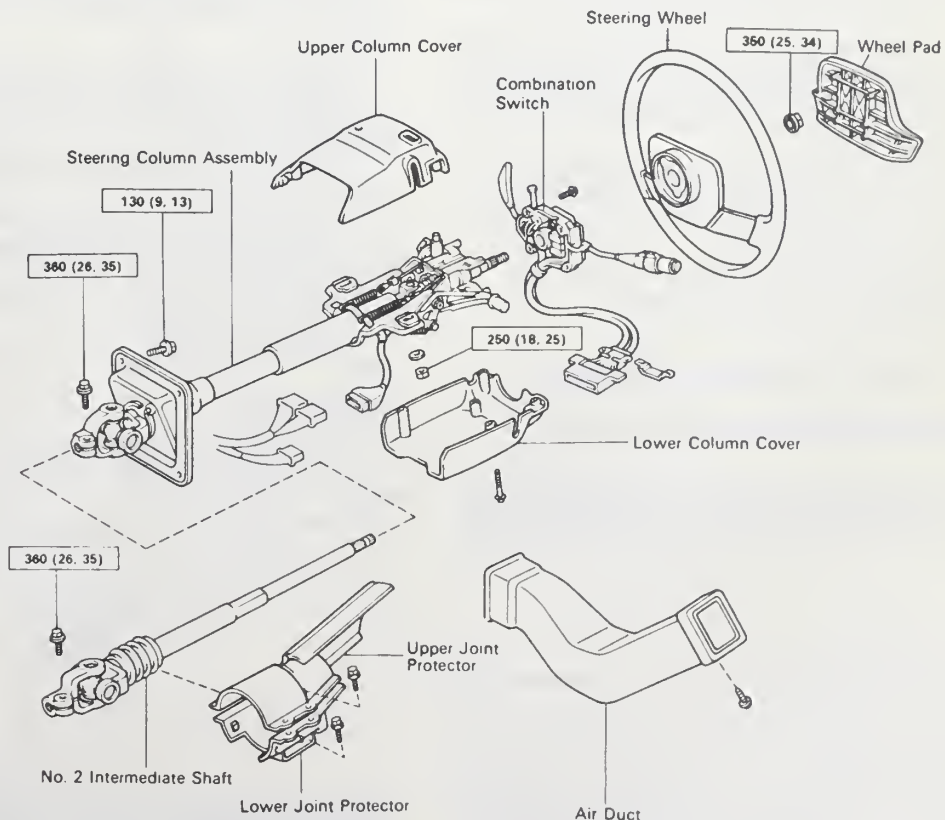


Always make matchmarks before disconnecting the column from the worm shaft

15. Reposition the floor hole cover and install the bolts.
16. Install the combination switch.
17. Connect the wiring harnesses for the ignition and combination switches.
18. Install the upper and lower steering column covers.
19. Install the heater duct; install the lower left dash trim panel.
20. Install the steering wheel and center pad.
21. Connect the negative battery cable.

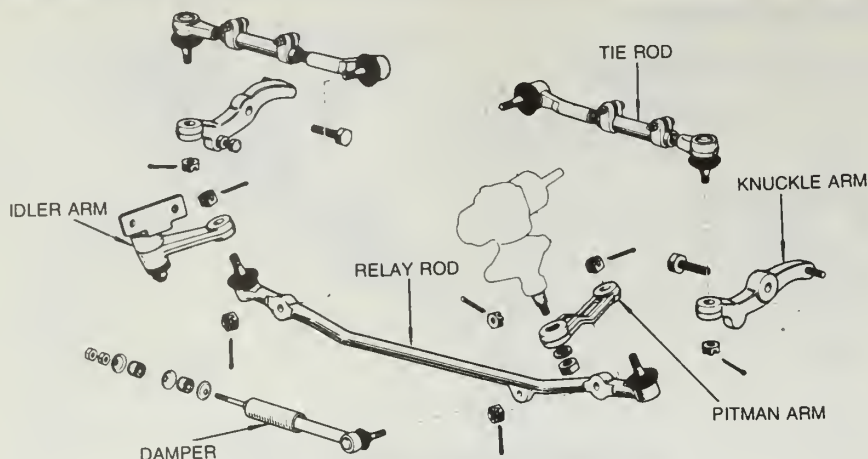
1989-90 Land Cruiser

1. Disconnect the negative battery cable.
2. Remove the center pad and the steering wheel.



1989-90 Land Cruiser steering column

8 SUSPENSION AND STEERING



Steering linkage components – 2WD trucks

3. Remove the upper and lower steering column covers.
4. Disconnect the wiring harnesses for the combination and ignition switches. Remove the combination switch.
5. Remove the lower left air duct under the dash.
6. Remove the bolts holding the steering hole cover to the floorboard. Slide the cover up the shaft.
7. Just behind the hole cover is a flexible joint holding the upper intermediate steering shaft to the lower intermediate shaft. The pinch bolt is at the engine side of the joint; matchmark the lower shaft and the joint. Loosen or remove the pinch bolt.
8. Have an assistant support the steering column in the vehicle. Remove the two nuts holding the column to the dashboard subframe.

9. Pull the column into the vehicle, releasing the flexible joint from the lower shaft. Remove the column from the cab.

To install:

10. Install the column assembly into the vehicle, fitting the flexible joint onto the lower shaft and aligning the matchmarks. Install the pinch bolt and tighten it to 26 ft. lbs. (35 Nm).
11. Lift the column into position and install the nuts; tighten them to 18 ft. lbs. (25 Nm).
12. Fit the hole cover into place and install the bolts.
13. Install the combination switch. Connect the harnesses for the ignition and combination switches.
14. Install the under dash air duct.
15. Install the upper and lower steering column covers.
16. Install the steering wheel and center pad.
17. Connect the negative battery cable.

2WD Truck Steering Linkage

REMOVAL AND INSTALLATION

NOTE: Before working on any of the following steering linkage components, disconnect the battery cable, raise the front of the truck and support it with safety stands.

Pitman Arm

1. Remove the strut bar.
2. Loosen the pitman arm nut.
3. Using a tie rod end puller or similar tool, disconnect the pitman arm from the sector shaft.
4. Using a tie rod end puller or similar tool, disconnect the pitman arm from the relay rod.
5. To install, align the marks on the pitman arm and sector shaft and connect them. Tighten the nut to 90 ft. lbs. (123 Nm).
6. Connect the arm to the relay rod and tighten the nut to 67 ft. lbs. (90 Nm).

7. Install the strut bar.

Tie Rod

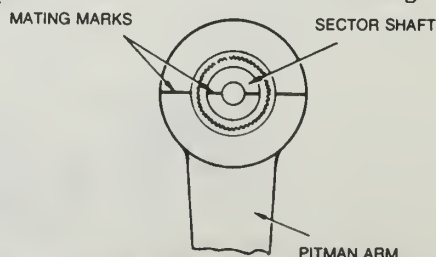
1. Using a tie rod end puller, disconnect the tie rod from the relay rod.
2. Using a tie rod end puller, disconnect the tie rod from the knuckle arm.
3. Remove the tie rod and remove the tie rod ends.
4. Screw the tie rod ends onto the tie rod. The tie rod length should be approximately 314.5mm. The remaining length of threads on both ends should always be equal.
5. Turn the tie rod ends so they cross at about 90°. Tighten the clamp nuts to 19 ft. lbs. (25 Nm).
6. Connect the tie rod to the knuckle arm and relay rod and tighten the mounting nuts to 67 ft. lbs. (90 Nm).

Relay Rod

1. Disconnect the tie rod ends from the relay rod.
2. Using a tie rod end puller, disconnect the pitman arm from the relay rod.
3. Using a tie rod end puller, disconnect the idler arm from the relay rod.
4. Remove the rod and inspect it for cracks or other damage.
5. Connect the relay rod to the idler arm to the relay rod and tighten the nut 43 ft. lbs. (59 Nm).
6. Connect the relay rod to the pitman arm and tighten the nut to 67 ft. lbs. (90 Nm).
7. Connect the tie rod ends to the relay rod and tighten the nuts to 67 ft. lbs. (90 Nm).

Knuckle Arm

1. Remove the front axle hub.
2. Disconnect the tie rod at the knuckle arm and remove the arm.
3. Inspect the arm for cracks or other damage.



The mating marks must be aligned when reinstalling the pitman arm

4. Install the arm to the steering knuckle and tighten the nut to 80 ft. lbs. (108 Nm).
5. Connect the tie rod to the knuckle arm and tighten the nut to 67 ft. lbs. (90 Nm).
6. Install the front axle hub.

Steering Damper

1. Disconnect the steering damper at the relay rod.
2. Disconnect the damper at the frame and remove the damper with all washers and cushions.
3. Install the damper to the frame bracket and tighten the nut to 9 ft. lbs. (13 Nm).
4. Connect the other end of the steering damper to the relay rod and tighten the nut to 43 ft. lbs. (59 Nm).

Idler Arm Bracket

1. Disconnect the relay rod from the idler arm.
2. Remove the 3 mounting bolts and remove the idler arm bracket with the arm attached.
3. Position the bracket and arm on the frame and tighten the bolts to 48 ft. lbs. (65 Nm).
4. Connect the idler arm to the relay rod and tighten the nut to 43 ft. lbs. (59 Nm).

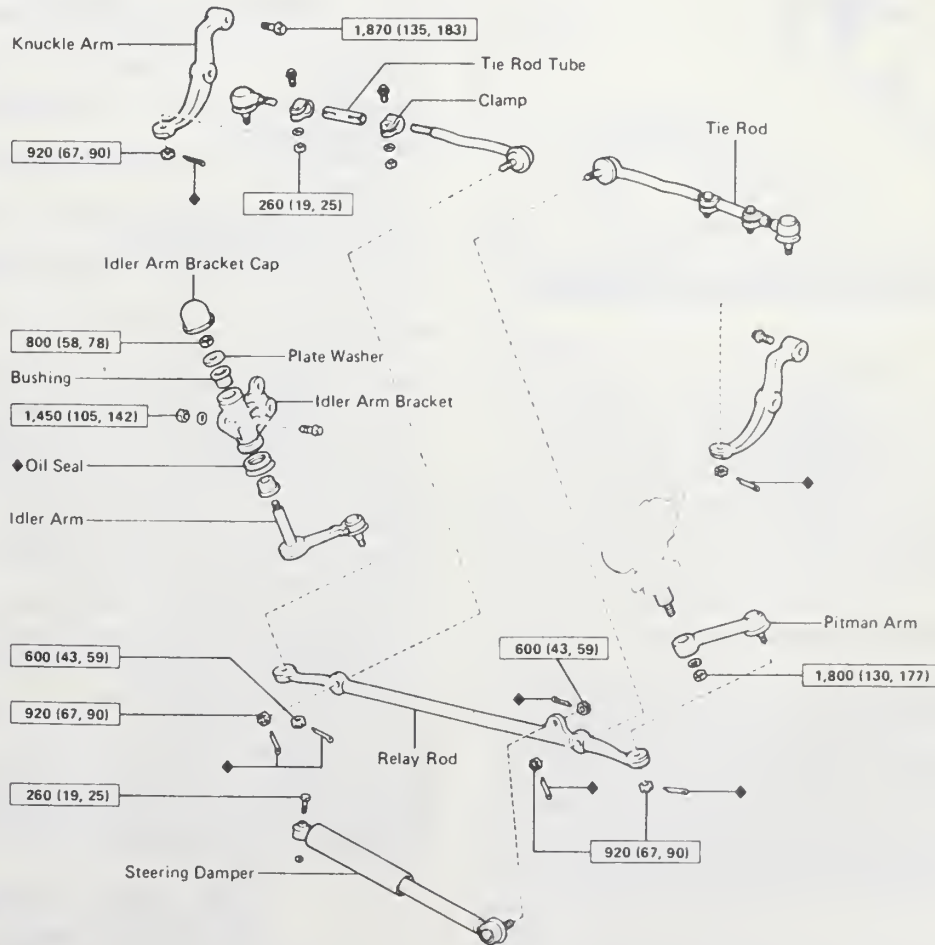
4WD Truck and 4Runner Steering Linage

REMOVAL AND INSTALLATION

NOTE: Before working on any of the following steering linkage components, raise the front of the truck and support it with safety stands.

Pitman Arm

1. Remove the pitman arm set nut and washer.
2. Using a tie rod end puller or similar tool, disconnect the pitman arm from the sector shaft.
3. Using a tie rod end puller or similar tool, disconnect the pitman arm from the relay rod.
4. To install, align the marks on the pitman arm and sector shaft and connect them. Tighten the nut to 130 ft. lbs. (177 Nm).
5. Connect the arm to the relay rod and tighten the nut to 67 ft. lbs. (90 Nm). Install a new cotter pin.



kg·cm (ft·lb, N·m) : Specified torque

◆ Non-reusable part

4WD Truck and 4Runner steering linkage

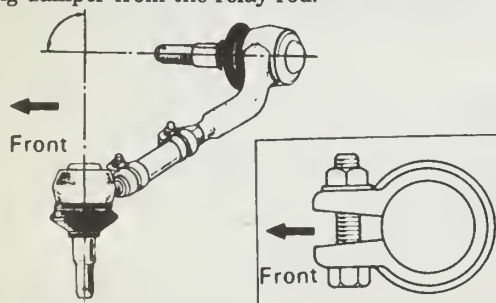
8 SUSPENSION AND STEERING

Tie Rod

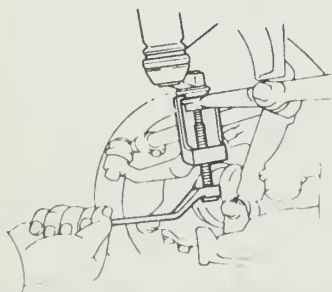
1. Using a tie rod end puller, disconnect the tie rod from the relay rod.
2. Using a tie rod end puller, disconnect the tie rod from the knuckle arm.
3. Remove the tie rod and remove the tie rod ends.
4. Screw the tie rod ends onto the tie rod. The tie rod length should be approximately 12.38 in. (314.5mm). The remaining length of threads on both ends should always be equal.
5. Turn the tie rod ends so they cross at about 90°. Tighten the clamp nuts to 19 ft. lbs. (25 Nm).
6. Connect the tie rod to the knuckle arm and relay rod and tighten the mounting nuts to 67 ft. lbs. (90 Nm).

Relay Rod

1. Disconnect the tie rod ends from the relay rod.
2. Using a tie rod end puller, disconnect the PITMAN arm from the relay rod.
3. Using a tie rod end puller, disconnect the idler arm from the relay rod.
4. Remove the rod and inspect it for cracks or other damage.
5. Remove the cotter pin and set nut and then disconnect the steering damper from the relay rod.



Set the tie rod ends correctly before installation



Always use a joint separator tool

6. Connect the relay rod to the idler arm to the relay rod and tighten the nut 43 ft. lbs. (59 Nm). Install a new cotter pin.
7. Connect the relay rod to the pitman arm and tighten the nut to 67 ft. lbs. (90 Nm). Install a new cotter pin.
8. Connect the tie rod ends to the relay rod and tighten the nuts to 67 ft. lbs. (90 Nm). Install new cotter pins.
9. Connect the steering damper to the relay rod and tighten the nut to 43 ft. lbs. (50 Nm). Install a new cotter pin.

Knuckle Arm

1. Disconnect the tie rod at the knuckle arm and remove the arm.
2. Inspect the arm for cracks or other damage.
3. Install the arm to the steering knuckle and tighten the nut to 120 ft. lbs. (162 Nm).
4. Connect the tie rod to the knuckle arm and tighten the nut to 67 ft. lbs. (90 Nm).

Steering Damper

1. Disconnect the steering damper at the relay rod.
2. Disconnect the damper at the frame and remove the damper with all washers and cushions.
3. Install the damper to the frame bracket and tighten the nut to 9 ft. lbs. (13 Nm).
4. Connect the other end of the steering damper to the relay rod and tighten the nut to 43 ft. lbs. (59 Nm). Install a new cotter pin.

Idler Arm Bracket

1. Disconnect the relay rod from the idler arm.
2. Remove the 3 mounting bolts and remove the idler arm bracket with the arm attached.
3. Position the bracket and arm on the frame and tighten the bolts to 70 ft. lbs. (95 Nm).
4. Connect the idler arm to the relay rod and tighten the nut to 43 ft. lbs. (59 Nm). Install a new cotter pin.

1989-90 Land Cruiser Steering Linkage

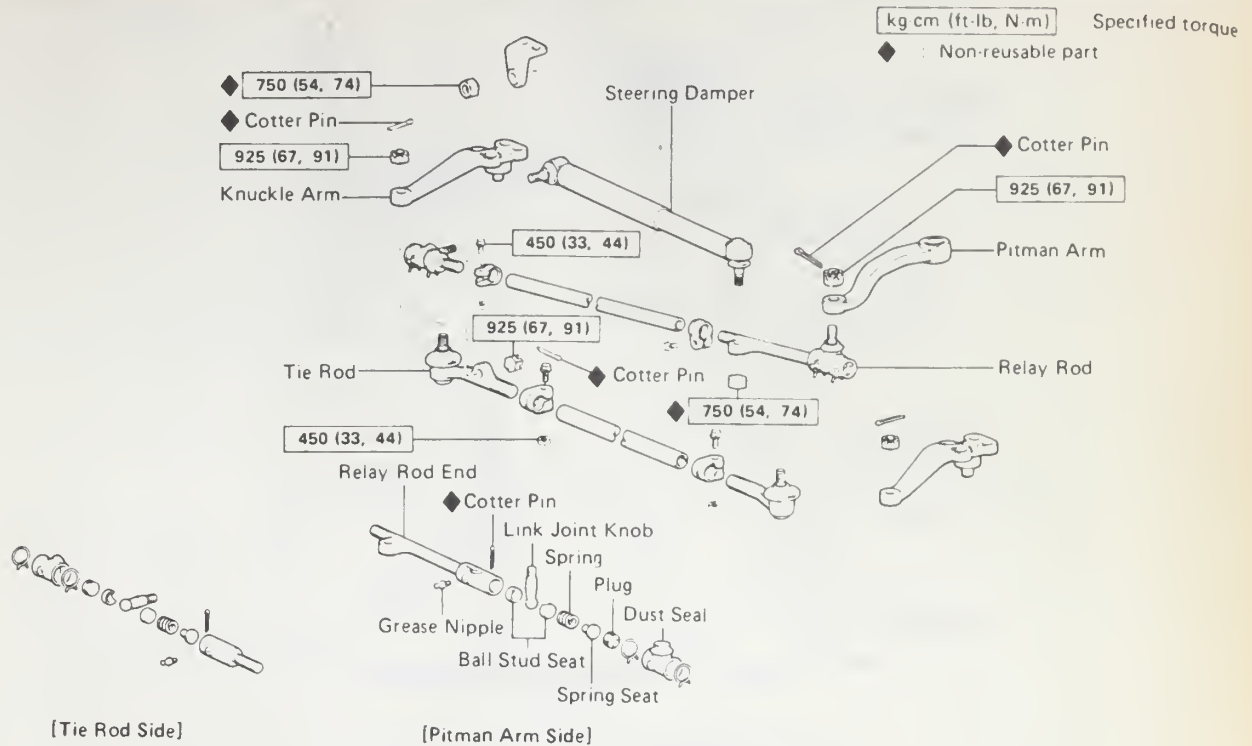
REMOVAL AND INSTALLATION

1. Raise the truck and support it with safety stands. Remove the wheels.
2. Remove the cotter pin and nut and disconnect the relay rod at the pitman arm.
3. Remove the cotter pin and nut and disconnect the tie rod at the knuckle arm.
4. Remove the mounting nut and disconnect the steering damper at the frame bracket.
5. Remove the nut and disconnect the steering damper at the relay rod.
6. Remove the cotter pin and nut and disconnect the relay rod at the tie rod.
7. To replace the tie rod ends, loosen the clamp and remove the ends. Install the ends and turn them in so they are approximately 1207mm apart. Tighten the clamps.
8. To replace the relay rod ends, loosen the end clamps and remove the ends. Remove the cotter pin. Remove the plug, 2 ball stud seats, link joint knob, spring and spring seat. Coat the parts with grease, install them and tighten the plug completely. Loosen the plug 1-1/3 turns and install a new cotter pin. Turn the rod ends onto the rod so they are 960mm apart. Tighten the clamp bolts to 33 ft. lbs. (44 Nm).
9. Connect the relay rod to the tie rod, tighten the nut to 67 ft. lbs. (90 Nm) and install a new cotter pin.
10. Connect the steering damper to the relay rod and tighten the nut to 54 ft. lbs. (74 Nm).
11. Connect the damper to the frame bracket and tighten the nut to 54 ft. lbs. (74 Nm).
12. Connect the tie rod to the knuckle arm, tighten the nut to 67 ft. lbs. (90 Nm) and install a new cotter pin.
13. Connect the relay rod to the pitman arm, tighten the nut to 67 ft. lbs. (90 Nm) and install a new cotter pin.
14. Install the wheels and lower the truck.

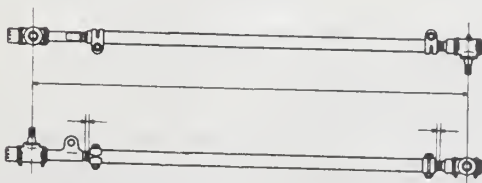
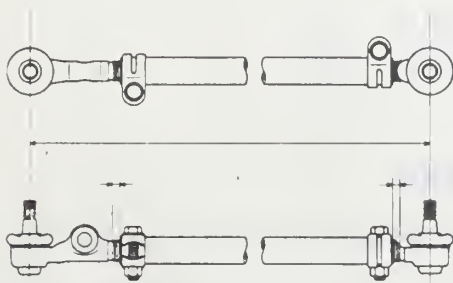
1991 Land Cruiser Steering Linkage

REMOVAL AND INSTALLATION

NOTE: Before working on any of the following steering linkage components, raise the front of the truck and support it with safety stands.



1989-90 Land Cruiser steering linkage



Set the correct length of the tie and relay rods before installation

Pitman Arm

1. Remove the pitman arm set nut and washer.
2. Using a tie rod end puller or similar tool, disconnect the pitman arm from the sector shaft.
3. Using a tie rod end puller or similar tool, disconnect the pitman arm from the relay rod.
4. To install, align the marks on the pitman arm and sector

shaft and connect them. Tighten the nut to 130 ft. lbs. (177 Nm).

5. Connect the arm to the relay rod and tighten the nut to 67 ft. lbs. (90 Nm). Install a new cotter pin.

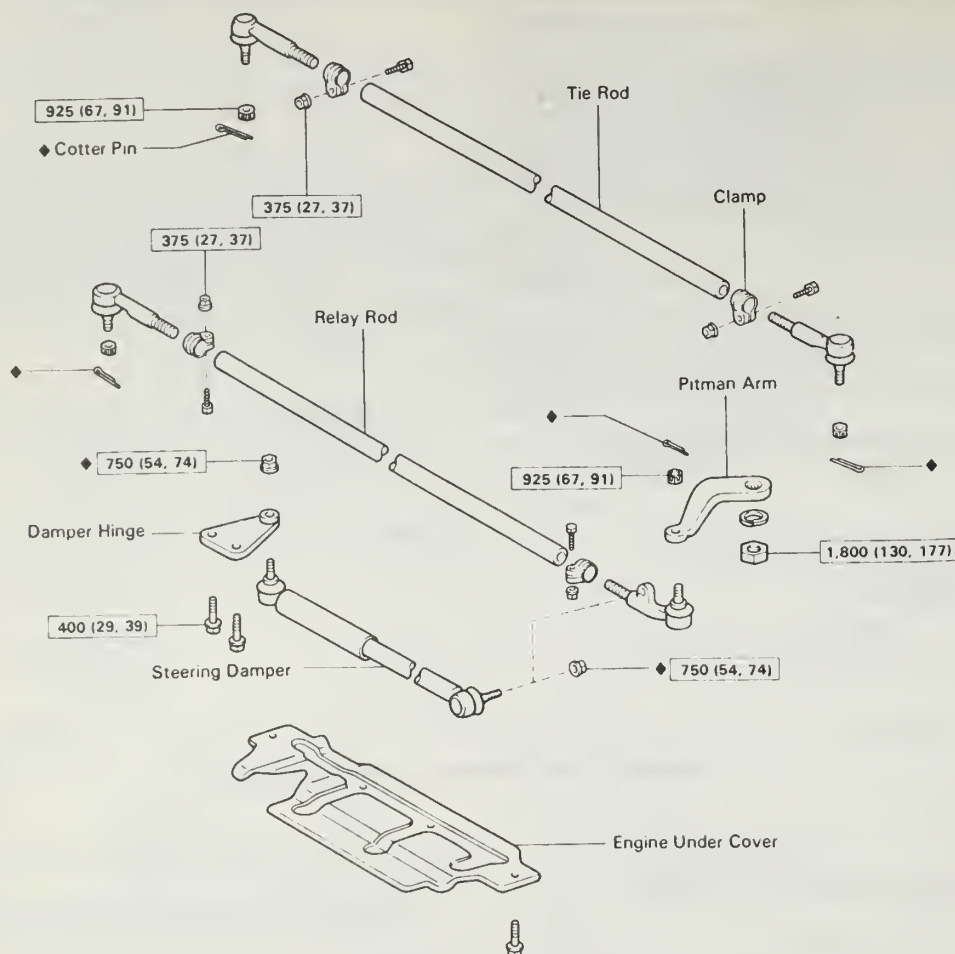
Tie Rod

1. Using a tie rod end puller, disconnect the tie rod from the knuckle arms.
2. Remove the tie rod and remove the tie rod ends.
3. Screw the tie rod ends onto the tie rod. The tie rod length should be approximately 1207mm (47.51 in.). The remaining length of threads on both ends should always be equal.
4. Turn the tie rod ends so they point in the same direction. Tighten the clamp nuts to 27 ft. lbs. (37 Nm).
5. Connect the tie rod to the knuckle arms; tighten the mounting nuts to 67 ft. lbs. (90 Nm).

Relay Rod

1. Disconnect the relay rod from the pitman arm.
2. Using a tie rod end puller, disconnect the pitman arm from the relay rod.
3. Disconnect the steering damper from the relay rod.
4. Disconnect the relay rod from the knuckle arm. Always use a joint separator tool.
5. Remove the rod and inspect it for cracks or other damage.
6. The relay rod ends are to be replaced, install them and set the length to approximately 1076mm or 42.34 inches. The amount of threads projecting from each side of the rod must be equal.
7. Set the rod ends so that the end for pitman arm (with the flange for the steering damper) faces up and the knuckle end points down. Tighten the clamp bolts to 27 ft. lbs. (37 Nm).
8. Install the rod loosely in position at the pitman arm and knuckle arm.
9. Tighten the pitman arm nut and the knuckle rod to 67 ft. lbs. (90 Nm). Install a new cotter pin in each fitting.

8 SUSPENSION AND STEERING



1991 Land Cruiser steering linkage

10. Connect the steering damper to the relay rod and tighten the nut to 43 ft. lbs. (50 Nm). Install a new cotter pin.

Knuckle Arm

1. Disconnect the tie rod at the knuckle arm and remove the arm.
2. Inspect the arm for cracks or other damage.
3. Install the arm to the steering knuckle and tighten the nut to 71 ft. lbs. (96 Nm).
4. Connect the tie rod to the knuckle arm and tighten the nut to 67 ft. lbs. (90 Nm).

Steering Damper

1. Disconnect the steering damper at the relay rod.
2. Disconnect the damper at the bracket and remove the damper with all washers and cushions.
3. Install the damper to the bracket and tighten the nut to 54 ft. lbs. (74 Nm).
4. Connect the other end of the steering damper to the relay rod and tighten the nut to 54 ft. lbs. (74 Nm).

Manual Steering Gear

ADJUSTMENTS

Adjustments to the manual steering gear are not necessary during normal service. Adjustments are performed only as part of overhaul.

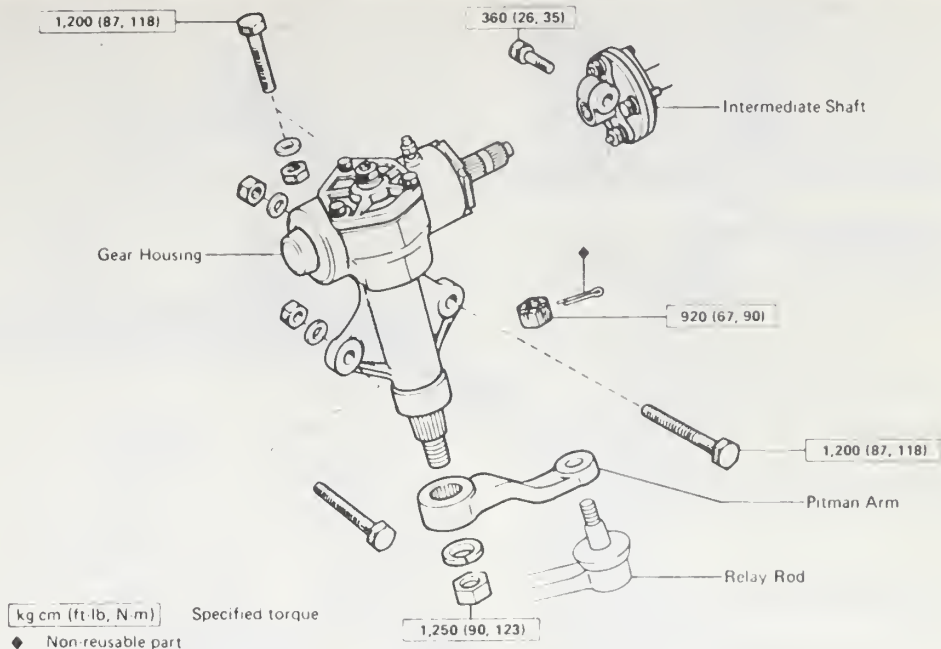
REMOVAL AND INSTALLATION

2WD Truck

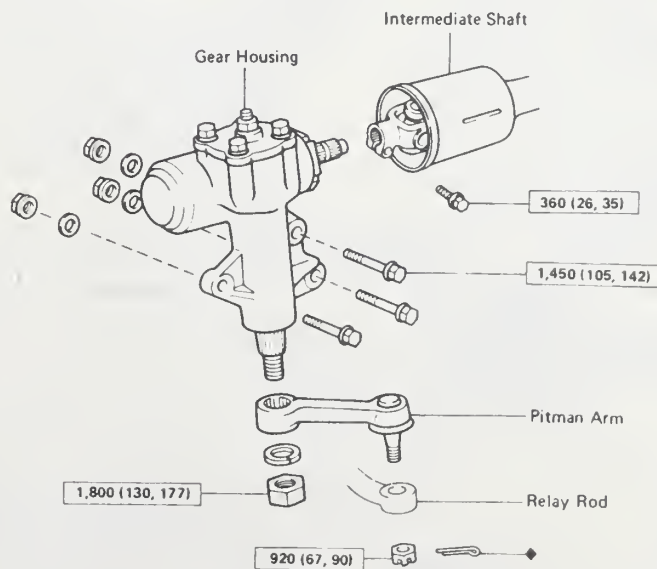
1. Remove the steering coupling set bolt where it connects to the worm shaft. Make matchmarks on the shaft and flexible coupling.
2. Disconnect the relay rod from the pitman arm.
3. Remove the 3 mounting bolts and lift out the steering gear housing.
4. Position the gear housing so that the worm shaft is lined up in the steering coupling and tighten the mounting bolts to 87 ft. lbs. (118 Nm).
5. Tighten the pitman arm mounting nut to 90 ft. lbs. (123 Nm).
6. Connect the pitman arm to the relay rod and tighten the nut to 67 ft. lbs. (90 Nm).
7. Tighten the coupling set bolt to 26 ft. lbs. (35 Nm).
8. Fill the gear housing with gear oil.

4WD Truck and 4Runner

1. Remove the joint protector set bolt.
2. Matchmark the universal joint to the worm shaft and remove the 2 U-joint bolts. Disconnect the U-joint from the worm shaft.



Manual steering box, 2WD truck



Manual steering box, 4WD truck and 4Runner

3. Remove the pitman arm set nut and then disconnect the arm from the gear housing.
4. Remove the 3 housing-to-frame mounting bolts and lift out the gear housing.

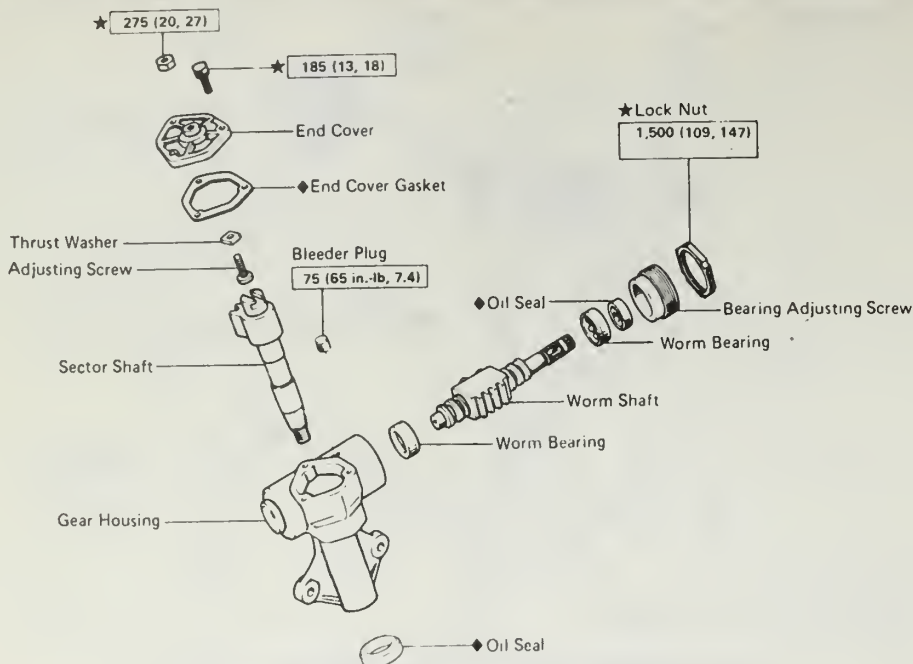
To install:

5. Position the housing and tighten the 3 bolts to 105 ft. lbs. (142 Nm).
6. Connect the U-joint to the worm shaft so that the marks are in alignment and tighten the bolts to 26 ft. lbs. (35 Nm).
7. Install the joint protector and its bracket set bolt.
8. Connect the pitman arm and tighten the nut to 130 ft. lbs. (177 Nm).

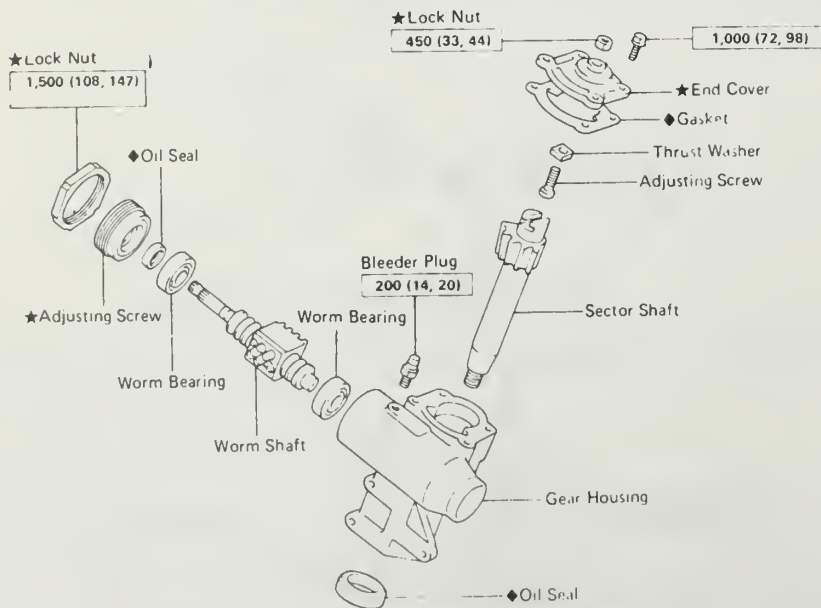
OVERHAUL

1. With the steering gearbox removed, mount the gearbox in a vise.
2. Remove the bleeder plug and drain the gear oil.
3. Remove the adjusting screw lock nut and the 3 bolts. Remove the end cover by turning the adjusting screw clockwise.
4. Pull out the sector shaft and the adjusting screw from the housing.
5. Remove the locknut and bearing adjusting screws. Tools 09617-30030 and 09617-30020 or their equivalents will be required for this task.
6. Remove the worm shaft from the housing.

8 SUSPENSION AND STEERING



Manual steering gearbox components, 2WD truck



[kg cm (ft lb, N-m)] Specified torque

◆ Non reusable part

★ Precoated part

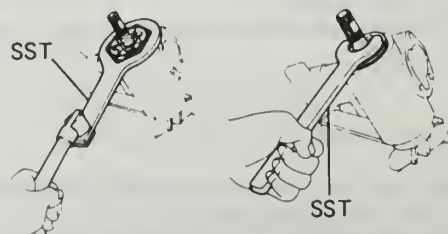
Manual steering gearbox components, 4WD truck

WARNING: The worm shaft has a small clip on it holding the internal balls. Do NOT remove the clip.

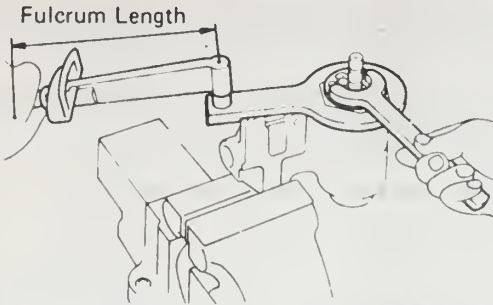
7. Check that the ball nut (the square-ish fitting on the shaft) moves smoothly up and down the worm. Do NOT allow the ball nut to hit the end of the worm shaft.

8. Inspect the seals, bearings and races for any sign of damage or deterioration. Replace the components as necessary.

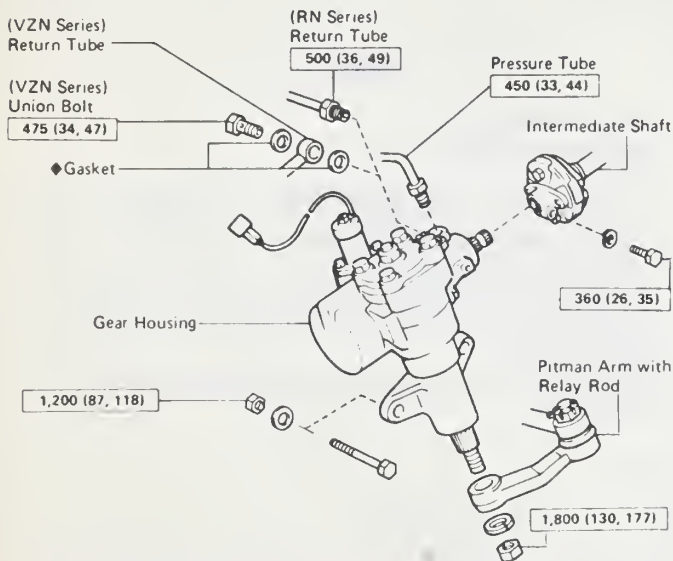
9. Inspect the sector shaft thrust clearance with a feeler gauge. Maximum allowable clearance is 0.05mm (0.0020 in) or less. If needed, install a new thrust washer to provide minimum clearance between the adjusting screw and shaft. Thrust wash-



Special tools will be required for disassembly of the gearbox



Checking the bearing preload requires a wrench of the correct fulcrum length or the specification is invalid



2WD power steering gearbox. VZN and RN types refer to different pump manufacturers

ers are available in 1.95, 2.00, 2.05, 2.10 and 2.15 millimeter thicknesses.

10. Apply multipurpose grease to the bushings, needle bearing and oil seals.

11. Install the worm bearings onto the shaft and install the shaft into the gear housing.

12. Install the bearing adjusting screw, using the correct special tool to tighten it just snug. Use a torque wrench and the correct tool, measure the bearing preload in each direction. Correct starting preload is 2.6–4.3 inch lbs. (0.3–0.5 Nm).

13. Apply sealant to the lock nut. Hold the adjusting screw in place and install the lock nut. Use the correct special tool to tighten the lock nut to 80 ft. lbs. (109 Nm).

14. Use a torque wrench with a fulcrum length of 425mm (16.73 inches) to check that the bearing preload is still correct.

15. Install the adjusting screw and thrust washer onto the sector shaft. Set the ball nut at the center of the worm shaft. Place the sector shaft into the gear housing so that the center teeth mesh together.

16. Install the end cover over a NEW gasket. Loosen the adjusting screw as far as possible.

17. Apply sealant to the bleeder side cover bolt. Install the cover bolts and tighten them to 13 ft. lbs. (18 Nm).

18. Turn the shaft fully to one side. Count the number of turns necessary to reach full lock in the opposite direction. Return the shaft one half of the number of turns; this puts the worm shaft in the centered or neutral position.

19. Place accurate matchmarks on the worm shaft and housing to show the neutral position.

20. Apply sealant to the adjusting screw lock nut. Hold the adjusting screw and tighten the locknut to 20 ft. lbs. (27 Nm).

21. Install a dial indicator; Check that the sector shaft has no backlash within 100 degrees to the left or right from the neutral position.

22. Install 380–400cc of SAE 90 gear oil. The oil level should be between 0.7 and 1.1 inches (18–28mm) below the fill hole when the unit is in its installed position. Install the hole plug.

Power Steering Gear

REMOVAL AND INSTALLATION

2WD Truck

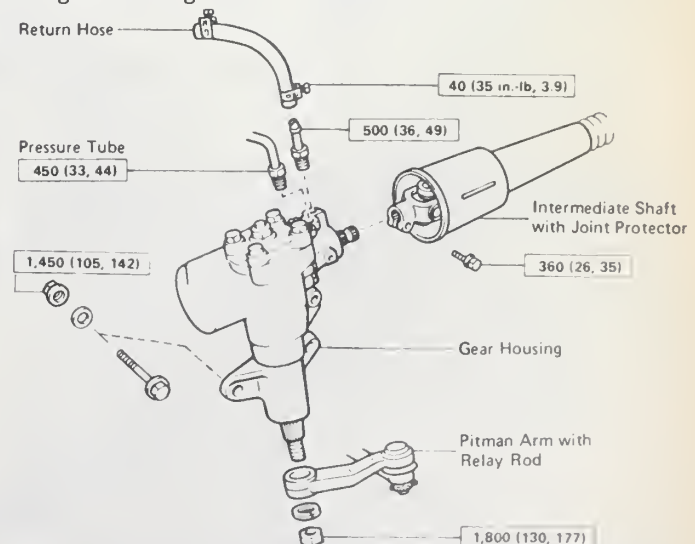
1. Remove the hydraulic line clamp bolts and disconnect the 2 lines at the housing.
2. Remove the steering coupling set bolt where it connects to the worm shaft.
3. Disconnect the relay rod from the pitman arm.
4. Remove the 3 mounting bolts and lift out the steering gear housing.

To install:

5. Position the gear housing so that the worm shaft is lined up in the steering coupling and tighten the mounting bolts to 87 ft. lbs. (118 Nm).
6. Tighten the pitman arm mounting nut to 130 ft. lbs. (177 Nm).
7. Connect the pitman arm to the relay rod and tighten the nut to 67 ft. lbs. (90 Nm).
8. Tighten the coupling set bolt to 26 ft. lbs. (35 Nm).
9. Connect the 2 hydraulic lines to the housing and tighten the union bolts to 35 ft. lbs. (48 Nm). Tighten the clamp bolts.
10. Fill the reservoir tank with fluid.

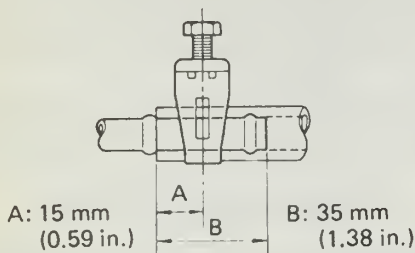
4WD Truck and 4Runner

1. Remove the joint protector set bolt.
2. Matchmark the universal joint to the worm shaft and remove the 2 U-joint bolts. Disconnect the U-joint from the worm shaft.
3. Remove the hydraulic line clamp bolts and disconnect the 2 lines at the housing.
4. Remove the pitman arm set nut and then disconnect the arm from the gear housing.
5. Remove the 3 housing-to-frame mounting bolts and lift out the gear housing.



4WD truck and 4Runner power steering gearbox external components

8 SUSPENSION AND STEERING



Correct Installation of power steering hose clamps

To install:

6. Position the housing and tighten the 3 bolts to 105 ft. lbs. (142 Nm).
7. Connect the 2 hydraulic lines to the housing and tighten the union bolts to 33 ft. lbs. (44 Nm). Tighten the clamp bolts.
8. Connect the U-joint to the worm shaft so that the marks are in alignment and tighten the bolts to 26 ft. lbs. (35 Nm).
9. Install the joint protector and its bracket set bolt.
10. Connect the pitman arm and tighten the nut to 130 ft. lbs. (177 Nm).
11. Fill the reservoir with fluid.

Land Cruiser

1. Remove the hydraulic line clamp bolts and disconnect the 2 lines at the housing.
2. Remove the joint protector set bolt.

3. Matchmark the universal joint to the worm shaft and remove the 2 U-joint bolts. Disconnect the U-joint from the worm shaft.

4. Remove the pitman arm set nut and then disconnect the arm from the gear housing.

5. Remove the 4 mounting bolts and lift out the gear housing.

To install:

6. Position the housing and tighten the 4 bolts to 105 ft. lbs. (142 Nm).

7. Connect the 2 hydraulic lines to the housing and tighten the union bolts to 33 ft. lbs. (44 Nm). Tighten the clamp bolts.

8. Connect the U-joint to the worm shaft so that the marks are in alignment and tighten the bolts to 26 ft. lbs. (35 Nm).

9. Install the joint protector and bracket bolt.

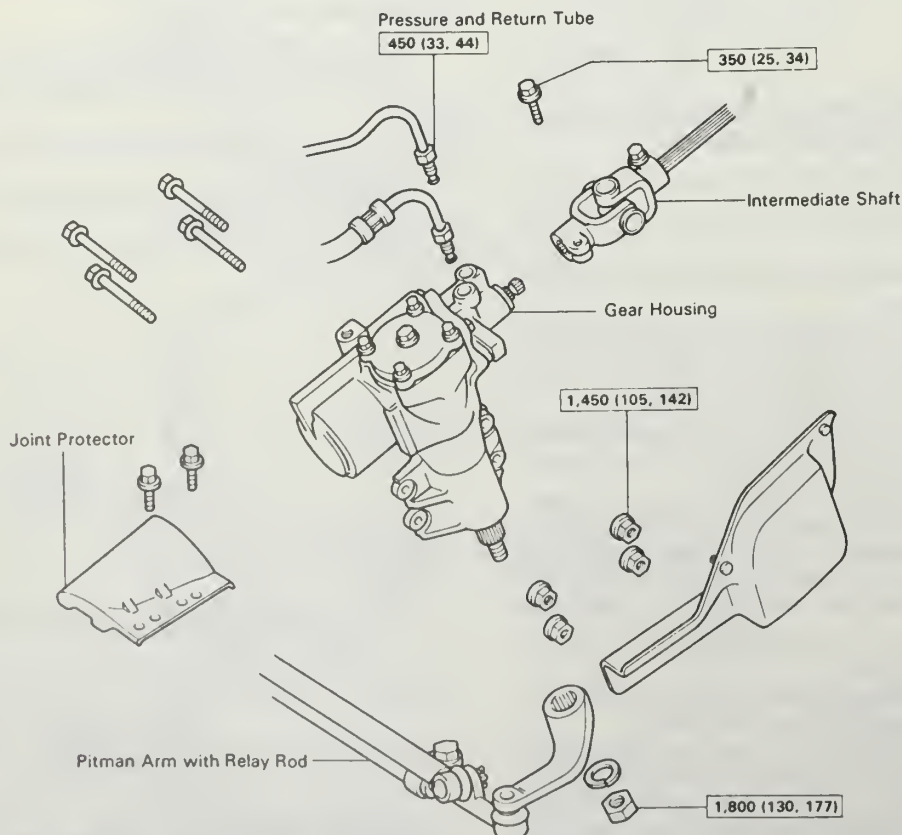
10. Connect the pitman arm and tighten the nut to 130 ft. lbs. (177 Nm).

OVERHAUL

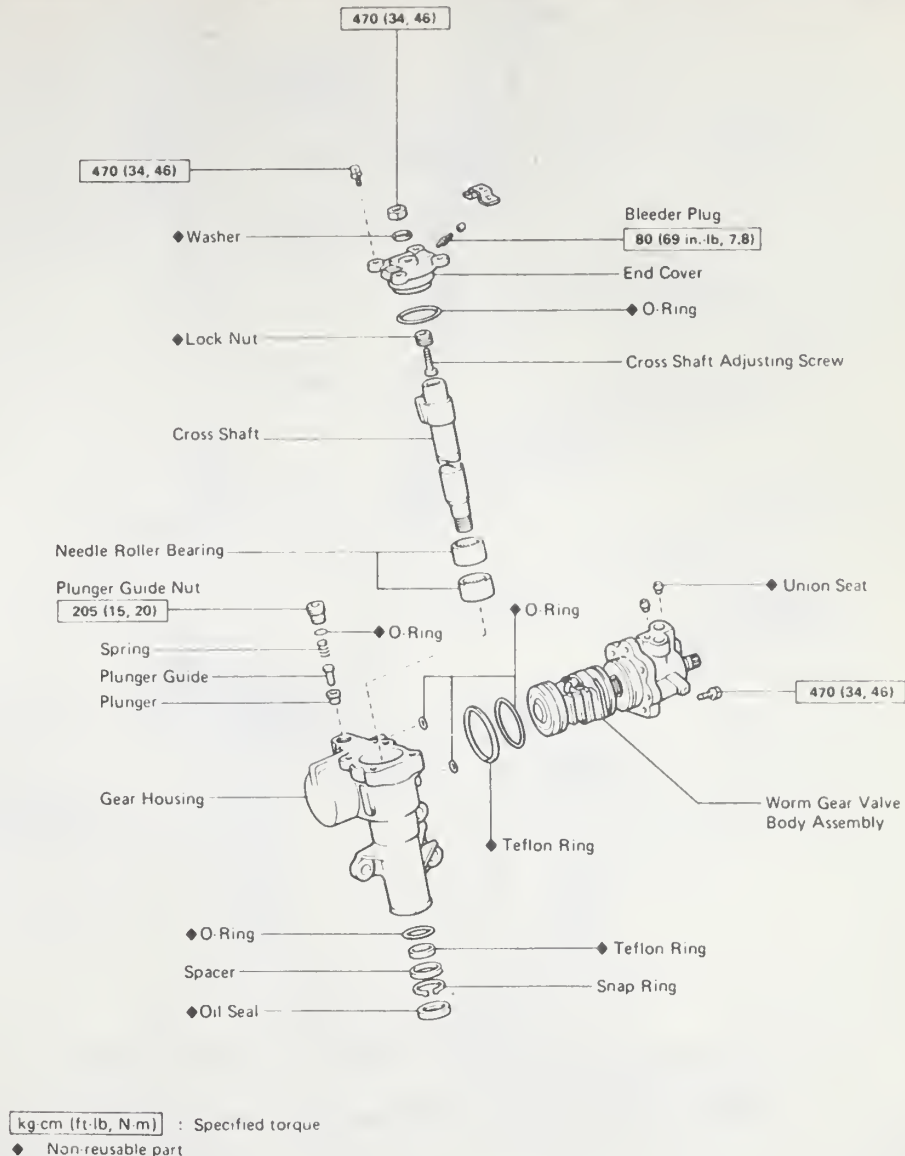
Truck and 4Runner

1991 Land Cruiser

1. Remove the power steering gearbox. Mount it in a vise with protected jaws or mount it to a plate held by a vise.
2. If equipped with PPS (progressive power steering), remove the solenoid valve and the O-rings.
3. Remove the adjusting screw locknut and the 4 bolts. Turn the adjusting screw clockwise until the cover comes off.
4. Using a plastic mallet, tap on the end of the cross shaft and remove the shaft.
5. Remove the plunger guide nut. Remove the spring, plunger and guide.



1991 Land Cruiser power steering gearbox. 1989-90 similar



Power steering gearbox components – 4WD truck and 4Runner

6. Remove the cap bolts from the housing. Use tool 09616-00010 or its equivalent to turn the worm shaft clockwise while holding the power piston nut so it cannot move.

7. Pull out the valve body. Do NOT allow the power piston nut to come off the worm shaft. Remove the O-ring.

8. Mount the valve body in a vise. Set up a dial indicator to measure the ball clearance.

9. Move the worm gear up and down; maximum ball clearance is 0.15mm (0.0059 in.). Greater clearance requires replacement of the power control valve assembly.

10. Place the cross shaft in a vise and set a dial indicator to measure thrust clearance. Clearance must be 0.03–0.05mm. If the clearance is not correct, adjust the clearance.

- Remove the staking from the lock nut.
- Remove the lock nut.
- Adjust the adjusting screw to gain the correct thrust clearance.
- Install and tighten a new lock nut. Stake the nut.

11. Inspect the bearings, races, seals and seats for any sign of damage or deformation. Replace components as needed.

12. Install three new O-rings to the housing and valve body. Install the worm gear valve body assembly.

13. Install the 4 bolts and tighten them to: Truck and 4Runner, 34 ft. lbs. (46 Nm) or Land Cruiser, 45 ft. lbs. (61 Nm).

14. Install the plunger, guide and spring. Install a new O-ring to the guide nut and tighten it to 15 ft. lbs. (20 Nm).

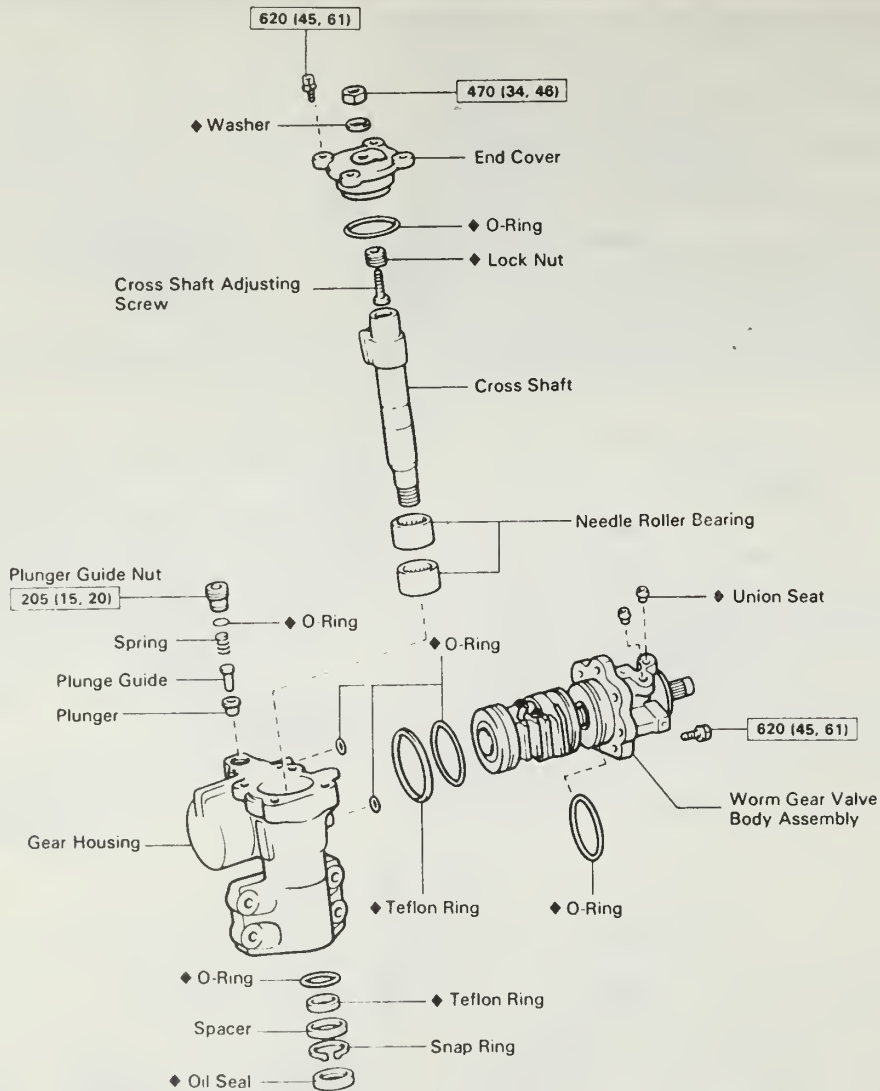
15. Install a new O-ring onto the end cover. Loosen the adjusting screw all the way and assemble the cross shaft to the end cover. Set the worm gear at the center of the housing.

16. Insert the cross shaft and push it into the gear housing so that the center teeth mesh.

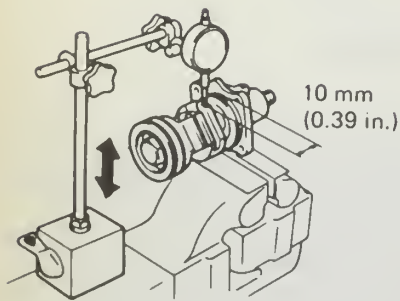
17. Tighten the 4 bolts to: Truck and 4Runner, 34 ft. lbs. (46 Nm) or Land Cruiser, 45 ft. lbs. (61 Nm).

18. Turn the worm shaft lock to lock, counting the revolutions. Return the shaft ½ the number of revolutions; this will center the shaft.

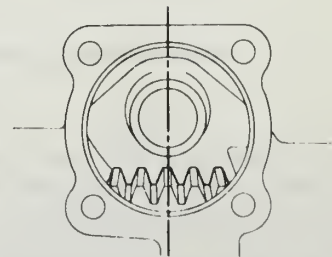
8 SUSPENSION AND STEERING



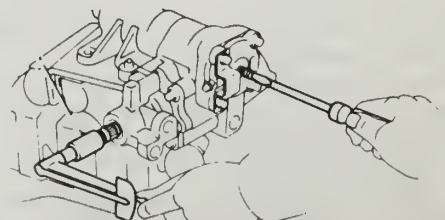
Power steering gearbox components – Land Cruiser



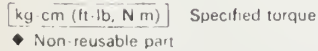
Check the ball clearance (above) and the adjusting screw thrust clearance



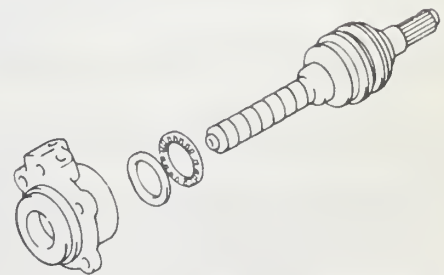
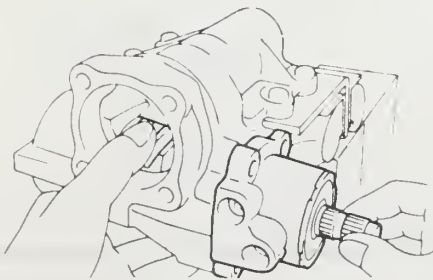
The gear must be centered in the housing at reassembly



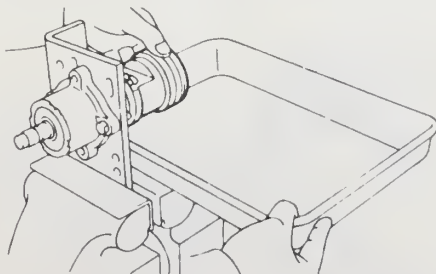
Adjust the preload with the adjusting screw



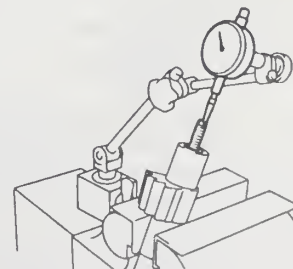
1989-90 Land Cruiser power steering gearbox components



Remove the worm shaft and components



Carefully hold the power piston nut with while removing the worm gear valve body assembly. Then remove the power piston nut



Measuring the adjusting screw thrust clearance

8 SUSPENSION AND STEERING

19. Install a torque wrench on the worm shaft. Turn the adjusting screw while measuring the preload on the shaft. Correct preload is: Truck and 4Runner 4.3–8.3 inch lbs. (0.5–0.9 Nm) or Land Cruiser, 6.5–9.6 inch lbs. (0.74–1.57 Nm).

20. Install a new washer; install and tighten the lock nut while holding the adjusting screw in place.

21. Install the solenoid valve for the PPS if it was removed. Use new O-rings.

1989–90 Land Cruiser

1. Mount the removed power steering gearbox in a vise with protected jaws or bolt it to a support bracket held in the vise. Remove the pitman arm.

2. Remove the adjusting screw lock nut. Remove the 4 bolts. Turn the adjusting screw clockwise until the cover is released. Remove the O-ring.

3. Use a plastic hammer to tap on the cross shaft end; remove the shaft.

4. Remove the four cap bolts from the valve body. Hold the power piston nut so it cannot turn. Turn the worm shaft counterclockwise. Remove the valve body and the power piston. Do NOT allow the power piston nut to come off the worm shaft.

5. Remove the power piston nut. Do NOT lose the balls; use a pan to catch them.

6. Hold the adjusting screw and remove the lock nut. Remove the adjusting screw, then remove the bearing.

7. Remove the O-ring.

8. Remove the worm shaft, thrust bearing, washer, Teflon ring and O-ring.

9. Place the cross shaft in a vise and set a dial indicator to measure thrust clearance. Clearance must be 0.03–0.05mm. If the clearance is not correct, adjust the clearance.

a. Remove the staking from the lock nut.

b. Remove the lock nut.

c. Adjust the adjusting screw to gain the correct thrust clearance.

d. Install and tighten a new lock nut. Stake the nut.

10. Inspect the bearings, races, seals and seats for any sign of damage or deformation. Replace components as needed.

11. Coat all parts to be reassembled with power steering fluid.

12. Mount the valve body in a vise.

13. Install a new O-ring and Teflon ring. Make sure the rings achieve their proper shape inside the housing.

14. Install the worm shaft with the thrust bearing and the plate washer.

15. Install a new O-ring and bearing on the control valve.

16. Install and temporarily tighten the adjusting screw and lock nut.

17. Insert the power piston nut approximately ½ inch (13mm) from the worm shaft end. Align the ball transfer surface with the ball hole.

18. Insert the balls one at a time into the hole, turning the worm shaft a little with each insertion. Insert the 33 balls.

19. Install 11 balls in the guide; apply a bit of multipurpose grease to the ends of the guide to keep the balls in place.

20. Install the ball guide clamp, tightening it only to 26 inch lbs. (2.9 Nm).

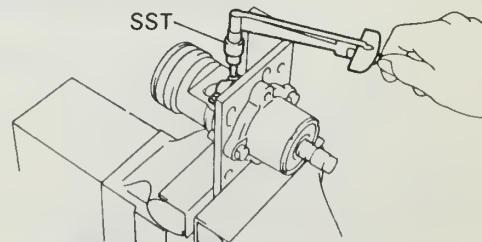
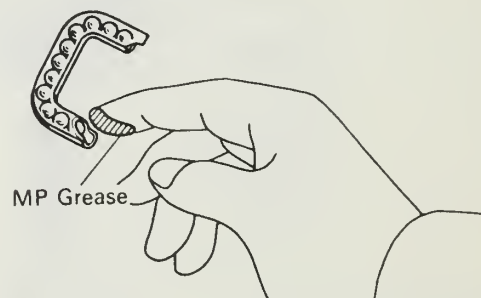
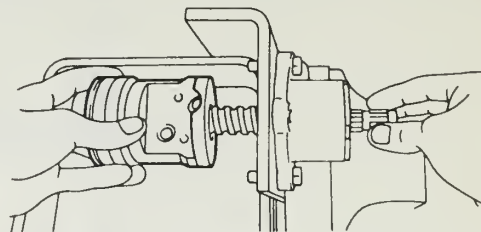
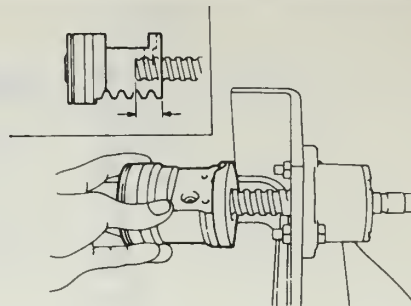
21. Check that the power piston turns freely. Turn the power piston nut to insure it is attached to the tip of the valve body. If a ball has fallen out, there will be a gap.

22. Install two new O-rings and install the worm gear valve body assembly.

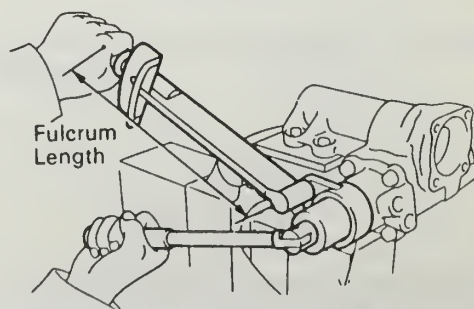
23. Remove the lock nut to adjust the worm bearing preload. Tighten the adjusting screw, turn the worm shaft left and right to seat the bearing, then slightly loosen the adjusting screw. Use a torque wrench to measure preload. Turn the adjusting screw slightly until the preload is 3.5–5.6 inch lbs (0.4–0.6 Nm).

24. Hold the adjusting screw in place and tighten the lock nut.

25. Use a torque wrench with a fulcrum length of 340mm to recheck the preload.



Steps in the correct insertion of the steering balls



Final checking the preload for the worm bearing

26. Install the cross shaft and end cover. Use a new O-ring. Set the piston nut at the center of the gear housing. Insert the cross shaft and push into the gear housing so that the center tooth meshes.

27. Loosen the adjusting screw fully; install the end cover and tighten the 4 bolts for the end cover to 34 ft. lbs. (46 Nm).

28. Turn the worm shaft full lock in both directions, counting the revolutions from lock to lock. From one lock point, return exactly half the total revolutions to place the shaft in the centered position.

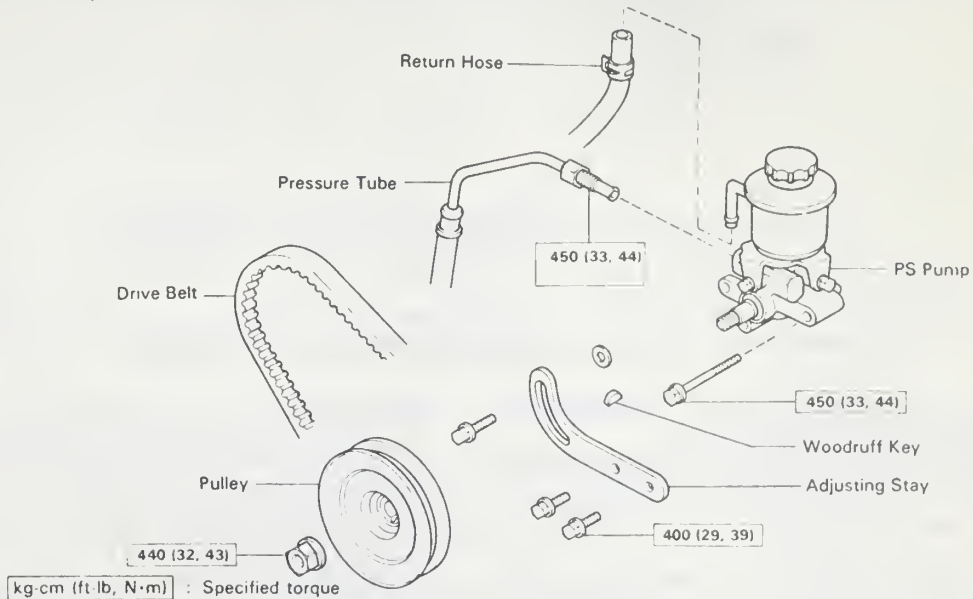
29. Use a torque wrench to measure total preload. Turn the adjusting screw while measuring the preload. Correct preload is 6.5–9.5 inch lbs. (0.7–1.1 Nm).

30. Once the correct preload is set, hold the adjusting screw in place and tighten the locknut. Tighten the locknut to 34 ft. lbs. (46 Nm).

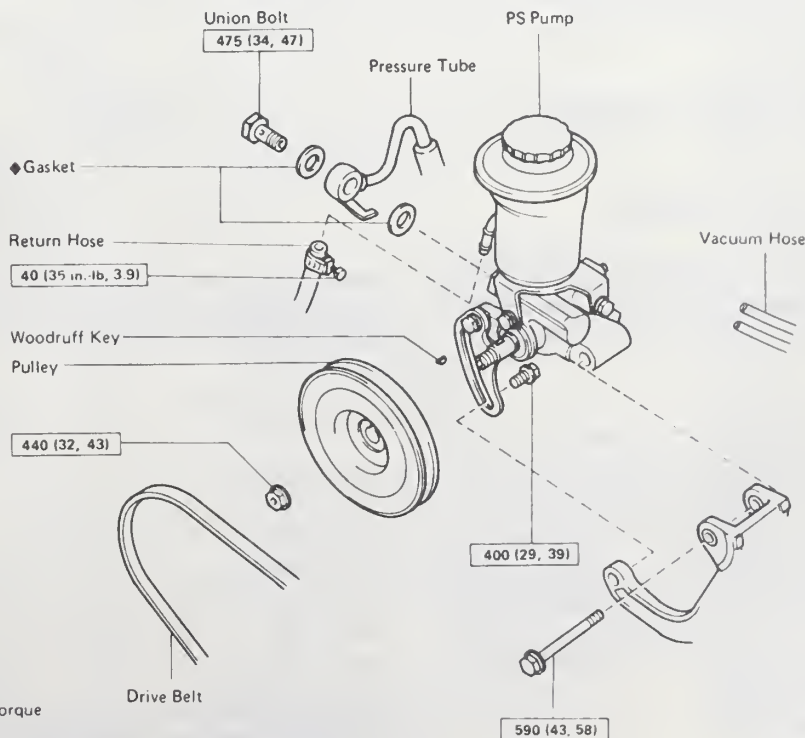
31. Use a punch and hammer to stake the lock nut in place.

Power Steering Pump REMOVAL AND INSTALLATION

1. Disconnect the high tension lines at the distributor and then disconnect the air lines at the air valve.
2. Suck some fluid out of the reservoir tank.

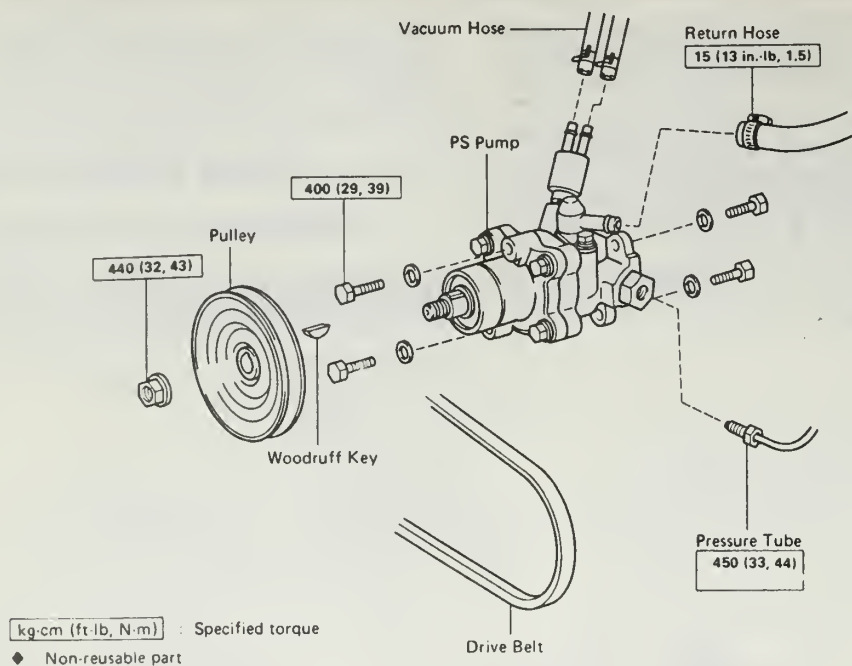


Land Cruiser power steering pump



VZN type power steering pump used on trucks and 4Runners

8 SUSPENSION AND STEERING



RN series power steering pump used on trucks and 4Runners

3. Disconnect the return hose at the power steering pump.
4. Disconnect the pressure line at the pump.
5. Loosen the drive belt pulley retaining nut. Loosen the idler pulley and adjusting bolt and remove the drive belt.
6. Remove the drive pulley and woodruff key.
7. Remove the power steering pump.

To install:

8. Install the pump in its bracket and tighten the nuts to 29 ft. lbs. (39 Nm).
9. Install the drive pulley and belt. Tighten the pulley bolt to 32 ft. lbs. (43 Nm) and check the drive belt tension.
10. Connect the pressure line to the pump and tighten the flare nut to 33 ft. lbs. (44 Nm).
11. Connect the return hose.
12. Connect the air hoses and the high tension leads.
13. Fill the reservoir with fluid, bleed the system and check for leaks.

BLEEDING THE SYSTEM

WARNING: Vehicles equipped with rear wheel anti-lock (RWAL) brakes use a different bleeding procedure than those not so equipped. Bleeding the RWAL system requires the use of the electronic brake tester, an expensive unit usually found only at dealers.

Land Cruiser

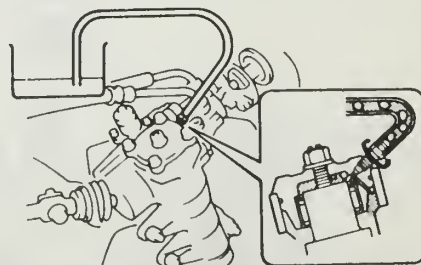
1. Check the fluid level in the reservoir. It should be at the correct level (HOT or COLD) depending on engine temperature.
2. Start the engine and run it below 1000 rpm.
3. Turn the steering wheel to full lock and hold it there 2-3 seconds. Turn the wheel to the opposite lock and hold it for 2-3 seconds. Repeat this procedure 2 or 3 times.
4. Inspect the fluid level with the engine running; the fluid should not be foamy or cloudy. Shut the engine off and check the fluid level; it should not rise more than 5mm (0.2 inch). If level rises too much, try re-bleeding the system. If the problem persists, repair the power steering system.

Truck and 4Runner without RWAL

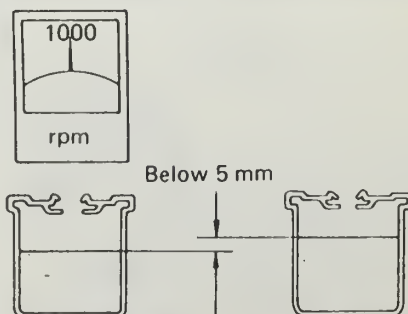
1. Check the fluid level in the reservoir. It should be at the

correct level (HOT or COLD) depending on engine temperature.

2. Start the engine and run it below 1000 rpm.
3. Turn the steering wheel from lock to lock 3 or 4 times.
4. Shut the engine off. Connect a clear plastic tube to the bleeder port on the steering gearbox. Place the other end of the tube in a container of power steering fluid. Make sure the end is immersed in the fluid.
5. Start the engine again. Turn the wheel lock to lock 3 or 4 times and return the steering wheel to the centered position.



Use a tightly fitting clear hose to bleed the power steering system on trucks and 4Runner without rear wheel anti-lock brakes



Check the fluid level change with the engine running and then switched off. Too great a change may indicate system problems

CAUTION

Do not allow the tubing to come off the bleed port. The power steering fluid is under high pressure and may be very hot.

6. Loosen the bleeder plug. Observe the tubing; when no air bubbles are seen, close the bleeder plug.

7. Inspect the fluid level with the engine running; the fluid should not be foamy or cloudy. Shut the engine off and check the fluid level; it should not rise more than 5mm (0.2 inch). If level rises too much, try re-bleeding the system. If the problem persists, repair the power steering system.

Truck and 4Runner with RWAL

The RWAL system uses power steering fluid pressure to maintain control pressures in the brake system. While the fluids never mix, air in the power steering system can render the rear anti-lock brakes ineffective.

If the any of the lines or components in the power steering system are loosened or removed, the brake system must be bled as well. Preliminary bleeding of both the power steering and brake systems will eliminate most of the air, but the vehicle **MUST** be taken to a dealer to have the systems properly bled using the Toyota ABS Checker. Be warned that until this is done, the rear wheel anti-lock brake function may be impaired.

Troubleshooting the Manual Steering Gear

Problem	Cause	Solution
Hard or erratic steering	• Incorrect tire pressure • Insufficient or incorrect lubrication • Suspension, or steering linkage parts damaged or misaligned • Improper front wheel alignment • Incorrect steering gear adjustment • Sagging springs	• Inflate tires to recommended pressures • Lubricate as required (refer to Maintenance Section) • Repair or replace parts as necessary • Adjust incorrect wheel alignment angles • Adjust steering gear • Replace springs
Play or looseness in steering	• Steering wheel loose • Steering linkage or attaching parts loose or worn • Pitman arm loose • Steering gear attaching bolts loose • Loose or worn wheel bearings • Steering gear adjustment incorrect or parts badly worn	• Inspect shaft spines and repair as necessary. Tighten attaching nut and stake in place. • Tighten, adjust, or replace faulty components • Inspect shaft splines and repair as necessary. Tighten attaching nut and stake in place • Tighten bolts • Adjust or replace bearings • Adjust gear or replace defective parts
Wheel shimmy or tramp	• Improper tire pressure • Wheels, tires, or brake rotors out-of-balance or out-of-round • Inoperative, worn, or loose shock absorbers or mounting parts • Loose or worn steering or suspension parts • Loose or worn wheel bearings • Incorrect steering gear adjustments • Incorrect front wheel alignment	• Inflate tires to recommended pressures • Inspect and replace or balance parts • Repair or replace shocks or mountings • Tighten or replace as necessary • Adjust or replace bearings • Adjust steering gear • Correct front wheel alignment

8 SUSPENSION AND STEERING

Troubleshooting the Manual Steering Gear

Problem	Cause	Solution
Tire wear	• Improper tire pressure • Failure to rotate tires • Brakes grabbing • Incorrect front wheel alignment • Broken or damaged steering and suspension parts • Wheel runout • Excessive speed on turns	• Inflate tires to recommended pressures • Rotate tires • Adjust or repair brakes • Align incorrect angles • Repair or replace defective parts • Replace faulty wheel • Make driver aware of conditions
Vehicle leads to one side	• Improper tire pressures • Front tires with uneven tread depth, wear pattern, or different cord design (i.e., one bias ply and one belted or radial tire on front wheels) • Incorrect front wheel alignment • Brakes dragging • Pulling due to uneven tire construction	• Inflate tires to recommended pressures • Install tires of same cord construction and reasonably even tread depth, design, and wear pattern • Align incorrect angles • Adjust or repair brakes • Replace faulty tire

Troubleshooting the Power Steering Gear

Problem	Cause	Solution
Hissing noise in steering gear	• There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and performance of the steering. Hiss may be expected when steering wheel is at end of travel or when slowly turning at standstill.	• Slight hiss is normal and in no way affects steering. Do not replace valve unless hiss is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure. Investigate clearance around flexible coupling rivets. Be sure steering shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates. Any metal-to-metal contacts through flexible coupling will transmit valve hiss into passenger compartment through the steering column.
Rattle or chuckle noise in steering gear	• Gear loose on frame • Steering linkage looseness • Pressure hose touching other parts of car • Loose pitman shaft over center adjustment	• Check gear-to-frame mounting screws. • Check linkage pivot points for wear. Replace if necessary. • Adjust hose position. Do not bend tubing by hand. • Adjust to specifications

Troubleshooting the Power Steering Gear (cont.)

Problem	Cause	Solution
Rattle or chuckle noise in steering gear	NOTE: A slight rattle may occur on turns because of increased clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle. • Loose pitman arm	• Tighten pitman arm nut to specifications
Squawk noise in steering gear when turning or recovering from a turn	• Damper O-ring on valve spool cut	• Replace damper O-ring
Poor return of steering wheel to center	• Tires not properly inflated • Lack of lubrication in linkage and ball joints • Lower coupling flange rubbing against steering gear adjuster plug • Steering gear to column misalignment • Improper front wheel alignment • Steering linkage binding • Ball joints binding • Steering wheel rubbing against housing • Tight or frozen steering shaft bearings • Sticking or plugged valve spool • Steering gear adjustments over specifications • Kink in return hose	• Inflate to specified pressure • Lube linkage and ball joints • Loosen pinch bolt and assemble properly • Align steering column • Check and adjust as necessary • Replace pivots • Replace ball joints • Align housing • Replace bearings • Remove and clean or replace valve • Check adjustment with gear out of car. Adjust as required. • Replace hose
Car leads to one side or the other (keep in mind road condition and wind. Test car in both directions on flat road)	• Front end misaligned • Unbalanced steering gear valve NOTE: If this is cause, steering effort will be very light in direction of lead and normal or heavier in opposite direction	• Adjust to specifications • Replace valve
Momentary increase in effort when turning wheel fast to right or left	• Low oil level • Pump belt slipping • High internal leakage	• Add power steering fluid as required • Tighten or replace belt • Check pump pressure. (See pressure test)
Steering wheel surges or jerks when turning with engine running especially during parking	• Low oil level • Loose pump belt • Steering linkage hitting engine oil pan at full turn • Insufficient pump pressure • Pump flow control valve sticking	• Fill as required • Adjust tension to specification • Correct clearance • Check pump pressure. (See pressure test). Replace relief valve if defective. • Inspect for varnish or damage, replace if necessary

8 SUSPENSION AND STEERING

Troubleshooting the Power Steering Gear (cont.)

Problem	Cause	Solution
Excessive wheel kickback or loose steering	• Air in system • Steering gear loose on frame • Steering linkage joints worn enough to be loose • Worn poppet valve • Loose thrust bearing preload adjustment • Excessive overcenter lash	• Add oil to pump reservoir and bleed by operating steering. Check hose connectors for proper torque and adjust as required. • Tighten attaching screws to specified torque • Replace loose pivots • Replace poppet valve • Adjust to specification with gear out of vehicle • Adjust to specification with gear out of car
Hard steering or lack of assist	• Loose pump belt • Low oil level NOTE: Low oil level will also result in excessive pump noise • Steering gear to column misalignment • Lower coupling flange rubbing against steering gear adjuster plug • Tires not properly inflated	• Adjust belt tension to specification • Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors. • Align steering column • Loosen pinch bolt and assemble properly • Inflate to recommended pressure
Foamy milky power steering fluid, low fluid level and possible low pressure	• Air in the fluid, and loss of fluid due to internal pump leakage causing overflow	• Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.
Low pressure due to steering pump	• Flow control valve stuck or inoperative • Pressure plate not flat against cam ring	• Remove burrs or dirt or replace. Flush system. • Correct
Low pressure due to steering gear	• Pressure loss in cylinder due to worn piston ring or badly worn housing bore • Leakage at valve rings, valve body-to-worm seal	• Remove gear from car for disassembly and inspection of ring and housing bore • Remove gear from car for disassembly and replace seals

Troubleshooting the Power Steering Pump

Problem	Cause	Solution
Chirp noise in steering pump	• Loose belt	• Adjust belt tension to specification
Belt squeal (particularly noticeable at full wheel travel and stand still parking)	• Loose belt	• Adjust belt tension to specification
Growl noise in steering pump	• Excessive back pressure in hoses or steering gear caused by restriction	• Locate restriction and correct. Replace part if necessary.
Growl noise in steering pump (particularly noticeable at stand still parking)	• Scored pressure plates, thrust plate or rotor • Extreme wear of cam ring	• Replace parts and flush system • Replace parts
Groan noise in steering pump	• Low oil level • Air in the oil. Poor pressure hose connection.	• Fill reservoir to proper level • Tighten connector to specified torque. Bleed system by operating steering from right to left—full turn.
Rattle noise in steering pump	• Vanes not installed properly • Vanes sticking in rotor slots	• Install properly • Free up by removing burrs, varnish, or dirt
Swish noise in steering pump	• Defective flow control valve	• Replace part
Whine noise in steering pump	• Pump shaft bearing scored	• Replace housing and shaft. Flush system.
Hard steering or lack of assist	• Loose pump belt • Low oil level in reservoir NOTE: Low oil level will also result in excessive pump noise • Steering gear to column misalignment • Lower coupling flange rubbing against steering gear adjuster plug • Tires not properly inflated	• Adjust belt tension to specification • Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors. • Align steering column • Loosen pinch bolt and assemble properly • Inflate to recommended pressure
Foaming milky power steering fluid, low fluid level and possible low pressure	• Air in the fluid, and loss of fluid due to internal pump leakage causing overflow	• Check for leaks and correct. Bleed system. Extremely cold temperatures will cause system aeration should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from body. Check welsh plug and body for cracks. If plug is loose or body is cracked, replace body.

8 SUSPENSION AND STEERING

Troubleshooting the Power Steering Pump (cont.)

Problem	Cause	Solution
Low pump pressure	- Flow control valve stuck or inoperative - Pressure plate not flat against cam ring	- Remove burrs or dirt or replace. Flush system. - Correct
Momentary increase in effort when turning wheel fast to right or left	- Low oil level in pump - Pump belt slipping - High internal leakage	- Add power steering fluid as required - Tighten or replace belt - Check pump pressure. (See pressure test)
Steering wheel surges or jerks when turning with engine running especially during parking	- Low oil level - Loose pump belt - Steering linkage hitting engine oil pan at full turn - Insufficient pump pressure	- Fill as required - Adjust tension to specification - Correct clearance - Check pump pressure. (See pressure test). Replace flow control valve if defective.
Steering wheel surges or jerks when turning with engine running especially during parking (cont.)	Sticking flow control valve	Inspect for varnish or damage, replace if necessary
Excessive wheel kickback or loose steering	Air in system	Add oil to pump reservoir and bleed by operating steering. Check hose connectors for proper torque and adjust as required.
Low pump pressure	- Extreme wear of cam ring - Scored pressure plate, thrust plate, or rotor - Vanes not installed properly - Vanes sticking in rotor slots - Cracked or broken thrust or pressure plate	- Replace parts. Flush system. - Replace parts. Flush system. - Install properly - Freeup by removing burrs, varnish, or dirt - Replace part

TORQUE SPECIFICATIONS

Component	English	Metric
WHEELS		
Pickups		
2WD		
Steel wheels, single rear wheels:	101 ft. lbs.	137 Nm
Steel wheels, dual rear wheels:	170 ft. lbs.	230 Nm
4WD, steel or aluminum wheels:	76 ft. lbs.	103 Nm
4Runner, steel or aluminum wheels:	76 ft. lbs.	103 Nm
Land Cruiser:	116 ft. lbs.	157 Nm

TORQUE SPECIFICATIONS

Component	English	Metric
FRONT SUSPENSION		
Axle flange-to-hub nuts		
4WD Truck and 4Runner:	23 ft. lbs.	31 Nm
Land Cruiser:	26 ft. lbs.	35 Nm
Brake caliper bolts:	90 ft. lbs.	123 Nm
Brake line-to-caliper fitting:	11 ft. lbs.	15 Nm
Grease cap bolts		
2WD:	9 ft. lbs.	13 Nm
Hub-to-disc:	47 ft. lbs.	64 Nm
Knuckle bearing preload		
Land Cruiser:	6.6–13.2 lbs.	19–59 N
Leaf Springs		
Hanger pin bolt:	17 ft. lbs.	23 Nm
U-bolts nuts:	105 ft. lbs.	142 Nm
Hanger pin nut:	90 ft. lbs.	123 Nm
Shackle pin nut:	67 ft. lbs.	91 Nm
Lower ball joint nut		
2WD models:	94 ft. lbs.	127 Nm
4WD models:	105 ft. lbs.	142 Nm
Lower Control Arm		
2WD Truck:	166 ft. lbs.	226 Nm
4WD Truck and 4Runner:	145 ft. lbs.	196 Nm
Shock Absorber		
1989-90 Land Cruiser		
Lower:	47 ft. lbs.	64 Nm
Upper:	18 ft. lbs.	25 Nm
1991 Land Cruiser		
Upper and lower nuts:	51 ft. lbs.	69 Nm
2WD Pickup		
Lower:	13 ft. lbs.	(18 Nm)
Upper:	18 ft. lbs.	(25 Nm)
4WD Pickup and 4Runner		
Lower:	101 ft. lbs.	(137 Nm)
Upper:	18 ft. lbs.	25 Nm
Spindle mounting bolts		
Land Cruiser:	34 ft. lbs.	47 Nm
Stabilizer Bar (Sway Bar)		
2WD Truck		
End link nuts:	9 ft. lbs.	13 Nm
Center bracket bolts:	9 ft. lbs.	13 Nm
Land Cruiser		
Bar-to-bracket bolts:	13 ft. lbs.	18 Nm
Bar-to-axle tube bolts:	19 ft. lbs.	25 Nm
Small link top nuts:	13 ft. lbs.	18 Nm
4WD Truck and 4Runner		
Bar-to-control arm nuts:	19 ft. lbs.	25 Nm
Center bracket bolts:	9 ft. lbs.	13 Nm
Steering Knuckle Arm		
2WD Trucks:	80 ft. lbs.	108 Nm
4WD Truck and 4Runner:	135 ft. lbs.	183 Nm
Land Cruiser:	71 ft. lbs.	96 Nm
Strut Bar		
2WD Truck		
Rear mounting nut:	70 ft. lbs.	95 Nm
Front mounting nut:	90 ft. lbs.	123 Nm
Torsion bar anchor arm locknut:	61 ft. lbs.	83 Nm

8 SUSPENSION AND STEERING

TORQUE SPECIFICATIONS

Component	English	Metric
Upper ball joint bolts		
4Runner:	25 ft. lbs.	33 Nm
2WD Truck:	23 ft. lbs.	31 Nm
4WD Truck:	18 ft. lbs.	25 Nm
Upper Control Arm shaft bolts		
2WD Truck:	93 ft. lbs.	126 Nm
4WD Truck and 4Runner:	131 ft. lbs.	178 Nm
Wheel bearing adjusting nut		
Step 1:	43 ft. lbs.	59 Nm
Step 2:	back off until free	
Step 3		
Land Cruiser:	48 ft. lbs.	54 Nm
4WD Truck and 4Runner:	18 ft. lbs.	25 Nm
Wheel bearing locknut		
4WD Truck and 4Runner:	35 ft. lbs.	47 Nm
Land Cruiser:	47 ft. lbs.	63 Nm

REAR SUSPENSION

Coil Springs		
4Runner and 1991 Land Cruiser		
Spring follower-to-frame:	11 ft. lbs.	15 Nm
Lateral control rod nut		
4Runner:	101 ft. lbs.	137 Nm
1991 Land Cruiser:	130 ft. lbs.	177 Nm
Leaf Springs		
U-bolt nuts		
2WD, ½ ton truck:	108 ft. lbs.	147 Nm
2WD, 1 ton truck or Cab/Chassis:	90 ft. lbs.	123 Nm
4WD, Xtra Cab:	90 ft. lbs.	123 Nm
4WD truck, all other models:	108 ft. lbs.	147 Nm
1989-90 Land Cruiser:	105 ft. lbs.	142 Nm
Hanger pin nut		
Land Cruiser:	90 ft. lbs.	123 Nm
½ ton trucks:	116 ft. lbs.	158 Nm
1 ton trucks and chassis/cab:	67 ft. lbs.	91 Nm
Shackle pin:	67 ft. lbs.	91 Nm
Shock absorber		
4Runner and 1991 Land Cruiser		
Upper mount		
4Runner:	18 ft. lbs.	25 Nm
Land Cruiser:	37 ft. lbs.	50 Nm
Lower mount bolt:	47 ft. lbs.	64 Nm
1989-90 Land Cruiser		
Upper mount:	47 ft. lbs.	64 Nm
Lower mount:	27 ft. lbs.	37 Nm
2WD Truck		
Upper and Lower mounts:	19 ft. lbs.	25 Nm
4WD Truck		
Upper and Lower mounts:	53 ft. lbs.	72 Nm
Stabilizer Bar		
Bracket and cushion mounting bolts:	8 ft. lbs.	11 Nm
End link mounting bolts:	19 ft. lbs.	25 Nm

STEERING Steering Column

Steering Wheel center nut:	25 ft. lbs.	34 Nm
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TORQUE SPECIFICATIONS

Component	English	Metric
Steering Column		
Shaft-to-wormshaft bolt		
Truck and 4Runner:	26 ft. lbs.	35 Nm
1991 Land Cruiser:	25 ft. lbs.	34 Nm
1989-90 Land Cruiser:	26 ft. lbs.	35 Nm
Column retaining bolts:	19 ft. lbs.	25 Nm
Steering Linkage		
Idler Arm Bracket-to-frame		
2WD Truck:	48 ft. lbs.	65 Nm
4WD Truck and 4Runner:	70 ft. lbs.	95 Nm
Idler arm-to-relay rod		
2WD Truck:	43 ft. lbs.	59 Nm
Knuckle arm-to-knuckle		
4WD Truck and 4Runner:	120 ft. lbs.	162 Nm
1991 Land Cruiser:	71 ft. lbs.	96 Nm
Pitman arm-to-relay rod nut		
2WD Truck:	67 ft. lbs.	90 Nm
4WD Truck and 4Runner:	67 ft. lbs.	90 Nm
1989-90 Land Cruiser:	67 ft. lbs.	90 Nm
1991 Land Cruiser:	67 ft. lbs.	90 Nm
Pitman arm-to-sector shaft		
2WD Truck:	90 ft. lbs.	123 Nm
4WD Truck and 4Runner:	130 ft. lbs.	177 Nm
1991 Land Cruiser:	130 ft. lbs.	177 Nm
Relay rod-to-idler arm nut		
2WD Truck:	43 ft. lbs.	59 Nm
4WD Truck and 4Runner:	43 ft. lbs.	59 Nm
Relay Rod end clamp bolts		
1991 Land Cruiser:	27 ft. lbs.	37 Nm
Steering Damper-to-frame bracket		
2WD Truck:	9 ft. lbs.	13 Nm
4WD Truck and 4Runner:	9 ft. lbs.	13 Nm
1989-90 Land Cruiser:	54 ft. lbs.	74 Nm
1991 Land Cruiser:	54 ft. lbs.	74 Nm
Steering damper-to-relay rod		
2WD Truck:	43 ft. lbs.	59 Nm
4WD Truck and 4Runner:	43 ft. lbs.	50 Nm
1989-90 Land Cruiser:	54 ft. lbs.	74 Nm
1991 Land Cruiser:	43 ft. lbs.	50 Nm
Tie rod end clamp nuts		
2WD Truck:	19 ft. lbs.	25 Nm
4WD Truck and 4Runner:	19 ft. lbs.	25 Nm
1989-90 Land Cruiser:	33 ft. lbs.	44 Nm
1991 Land Cruiser:	27 ft. lbs.	37 Nm
Tie rod-to-knuckle arm and relay rod nuts		
2WD Truck:	67 ft. lbs.	90 Nm
4WD Truck and 4Runner:	67 ft. lbs.	90 Nm
1989-90 Land Cruiser:	67 ft. lbs.	90 Nm
1991 Land Cruiser:	67 ft. lbs.	90 Nm
Manual Steering Gear		
Pitman arm-to-sector shaft		
2WD Truck:	90 ft. lbs.	123 Nm
4WD Truck and 4Runner:	130 ft. lbs.	177 Nm
Steering Gear mounting bolts		
2WD Truck:	87 ft. lbs.	118 Nm
4WD Truck and 4Runner:	105 ft. lbs.	142 Nm
Worm bearing preload:	2.6-4.3 inch lbs.	0.3-0.5 Nm

8 SUSPENSION AND STEERING

TORQUE SPECIFICATIONS

Component	English	Metric
Worm bearing adjuster locknut:	80 ft. lbs.	109 Nm
Side cover bolts:	13 ft. lbs.	18 Nm
Power Steering Gear		
Adjusting screw locknut 1989-90 Land Cruiser:	34 ft. lbs.	46 Nm
Ball guide clamp 1989-90 Land Cruiser:	26 inch lbs.	2.9 Nm
Cross shaft bolts Truck and 4Runner: 1991 Land Cruiser:	34 ft. lbs. 45 ft. lbs.	46 Nm 61 Nm
End cover bolts 1989-90 Land Cruiser:	34 ft. lbs.	46 Nm
Guide nut Truck, 4Runner, 1991 Land Cruiser:	15 ft. lbs.	20 Nm
Hydraulic line union bolts 2WD Truck: 4WD Truck and 4Runner: Land Cruiser:	35 ft. lbs. 33 ft. lbs. 33 ft. lbs.	48 Nm 44 Nm 44 Nm
Pitman arm-to-sector shaft 2WD Truck: 4WD Truck and 4Runner: Land Cruiser:	130 ft. lbs. 130 ft. lbs. 130 ft. lbs.	177 Nm 177 Nm 177 Nm
Steering gear mounting bolts 2WD Truck: 4WD Truck and 4Runner: Land Cruiser:	87 ft. lbs. 105 ft. lbs. 105 ft. lbs.	118 Nm 142 Nm 142 Nm
Total preload 1989-90 Land Cruiser:	6.5-9.5 inch lbs.	0.7-1.1 Nm
Worm bearing preload 1989-90 Land Cruiser:	3.5-5.6 inch lbs	0.4-0.6 Nm
Worm gear valve body bolts Truck and 4Runner: 1991 Land Cruiser: 45 ft. lbs.	34 ft. lbs. 61 Nm	46 Nm
Worm shaft preload Truck and 4Runner: Land Cruiser:	4.3-8.3 inch lbs. 6.5-9.6 inch lbs.	0.5-0.9 Nm 0.74-1.57 Nm
Power Steering Pump		
Drive pulley bolt:	32 ft. lbs.	43 Nm
Pressure line-to-pump flare nut:	33 ft. lbs.	44 Nm
Pump-to-bracket nuts:	29 ft. lbs.	39 Nm

9 Brakes

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BASIC OPERATING PRINCIPLES

HYDRAULIC SYSTEM

Hydraulic systems are used to actuate the brakes of all modern automobiles. A hydraulic system rather than a mechanical system is used for two reasons. First, fluid under pressure can be carried to all parts of an automobile by small hoses—some of which are flexible—without taking up a significant amount of room or posing routing problems. Second, a great mechanical advantage can be given to the brake pedal, and the foot pressure required to actuate the brakes can be reduced by making the surface area of the master cylinder pistons smaller than that of any of the pistons in the wheel cylinders or calipers.

The master cylinder consists of a fluid reservoir and a single or double cylinder and piston assembly. Double type master cylinders are designed to separate the front and rear braking systems hydraulically in case of a leak. The master cylinder converts mechanical motion from the pedal into hydraulic pressure within the lines. This pressure is translated back into mechanical motion at the wheels by either the wheel cylinder (drum brakes) or the caliper (disc brakes). Since these components receive the pressure from the master cylinder, they are generically classed as slave cylinders in the system.

Steel lines carry the brake fluid to a point on the vehicle's frame near each of the vehicle's wheels. The fluid is then carried to the slave cylinders by flexible tubes in order to allow for suspension and steering movements.

Each wheel cylinder contains two pistons, one at either end, which push outward in opposite directions and force the brake shoe into contact with the drum. In disc brake systems, the slave cylinders are part of the calipers. One or four cylinders are used to force the brake pads against the disc, but all cylinders contain one piston only. All slave cylinder pistons employ some type of seal, usually made of rubber, to minimize the leakage of fluid around the piston. A rubber dust boot seals the outer end of the cylinder against dust and dirt. The boot fits around the outer end of either the piston or the brake actuating rod.

When at rest the entire hydraulic system, from the piston(s) in the master cylinder to those in the wheel cylinders or calipers, is full of brake fluid. Upon application of the brake pedal, fluid trapped in front of the master cylinder piston(s) is forced through the lines to the slave cylinders. Here it forces the pistons outward, in the case of drum brakes, and inward toward the disc in the case of disc brakes. The motion of the pistons is opposed by return springs mounted outside the cylinders in drum brakes, and by internal springs or spring seals, in disc brakes.

Upon release of the brake pedal, a spring located inside the master cylinder immediately returns the master cylinder piston(s) to the normal position. The pistons contain check valves and the master cylinder has compensating ports drilled within it. These are uncovered as the pistons reach their normal position. The piston check valves allow fluid to flow toward the wheel cylinders or calipers as the pistons withdraw. Then, as the return springs force the brake pads or shoes into the released position, the excess fluid in the lines is allowed to re-enter the reservoir through the compensating ports.

Dual circuit master cylinders employ two pistons, located one behind the other, in the same cylinder. The primary piston is actuated directly by mechanical linkage from the brake pedal. The secondary piston is actuated by fluid trapped between the two pistons. If a leak develops in front of the secondary pistons, it moves forward until it bottoms against the front of the master cylinder, and the fluid trapped between the pistons will operate the rear brakes. If the rear brakes develop a leak, the primary piston will move forward until direct contact with the secondary piston takes place, and it will force the secondary piston to actuate the front brakes. In either case, the brake pedal moves far-

ther when the brakes are applied and less braking power is available.

All dual-circuit systems incorporate a switch which senses either line pressure or fluid level. This system will warn the driver when only half of the brake system is operational.

In some disc brake systems, this valve body also contains a metering valve and, in some cases, a proportioning valve. The metering valve keeps pressure from traveling to the disc brakes on the front wheels until the brake shoes on the rear wheels have contacted the drum, ensuring that the front brakes will never be used alone. The proportioning valve controls the pressure to the rear brakes avoiding rear wheel lock-up during very hard braking.

DISC BRAKES

CAUTION

Brake pads contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from any brake surface. When cleaning brake surfaces, use a commercially available brake cleaning fluid.

Instead of the traditional expanding brakes that press outward against a circular drum, disc brake systems utilize a cast iron disc with brake pads positioned on either side of it. An easily seen analogy is the hand brake arrangement on a bicycle. The pads squeeze onto the rim of the bike wheel, slowing its motion. Automobile disc brakes use the identical principal but apply the braking effort to a separate disc instead of the wheel.

The disc or rotor is a one-piece casting mounted just inside the wheel. Some discs are one solid piece while others have cooling fins between the two braking surfaces. These vented rotors enable air to circulate between the braking surfaces cooling them quicker and making them less sensitive to heat buildup and fade. Disc brakes are only slightly affected by dirt and water since contaminants are thrown off by the centrifugal action of the rotor or scraped off by the pads. Also, the equal clamping action of the two brake pads tend to ensure uniform, straight-line stops, although unequal application of the pads between the left and right wheels can cause a vicious pull under braking. All disc brakes are inherently self-adjusting.

There are three general types of disc brakes:

- The fixed caliper design uses two pistons mounted on either side of the rotor (in each side of the caliper). The caliper is mounted rigidly and does not move. This is a very efficient brake system but the size of the caliper and its mounts adds weight and bulk to the vehicle.

- The sliding and floating designs are quite similar. In fact, these two types are often lumped together. In both designs, one is moved into contact with the rotor by hydraulic force. The caliper, which is not held in a fixed position, moves slightly, bringing the other pad into contact with the rotor. There are various methods of attaching floating calipers. Some pivot at the bottom or top, and some slide on mounting bolts. Many uneven brake wear problems can be caused by dirty or seized slides or pivots.

DRUM BRAKES

CAUTION

Brake shoes contain asbestos, which has been determined to be a cancer causing agent. never clean the brake surfaces with Compressed air. Avoid inhaling any dust from any brake surface. When cleaning brake surfaces, use a commercially available brake cleaning fluid.

Drum brakes employ two brake shoes mounted on a stationary backing plate. These shoes are positioned inside a circular cast iron drum which rotates with the wheel. The shoes are held

in place by springs; this allows them to slide toward the drum (when they are applied) while keeping the linings and drums in alignment. The shoes are actuated by a wheel cylinder which is mounted at the top of the backing plate. When the brakes are applied, hydraulic pressure forces the wheel cylinder's two actuating links outward. Since these links bear directly against the top of the brake shoes, the tops of the shoes are then forced outward against the inside of the drum. This action forces the bottoms of the two shoes to contact the brake drum by rotating the entire assembly slightly (known as servo action). When the pressure within the wheel cylinder is relaxed, return springs pull the shoes away from the drum.

Most modern drum brakes are designed to self-adjust during application when the vehicle is moving in reverse or when the parking brake is applied. This motion caused both shoes to rotate very slightly with the drum, rocking an adjusting lever, thereby causing rotation of the adjusting screw by means of a star wheel.

POWER BRAKE BOOSTER

Virtually all vehicles today use a vacuum assisted power brake system to multiply the braking force and reduce pedal effort. Since vacuum is always available when the engine is operating, the system is simple and efficient. A vacuum diaphragm is located on the front of the master cylinder and assists the driver in applying the brakes, reducing both the effort and travel the operator must put into moving the brake pedal.

The vacuum diaphragm housing is connected to the intake

manifold by a vacuum hose. A check valve is placed at the point where the hose enters the diaphragm housing, so that during periods of low manifold vacuum brake assist will not be lost.

Depressing the brake pedal closes off the vacuum source and allows atmospheric pressure to enter on one side of the diaphragm. This causes the master cylinder pistons to move and apply the brakes. When the brake pedal is released, vacuum is applied to both sides of the diaphragm and springs return the diaphragm and master cylinder pistons to the released position.

If the vacuum supply fails, the brake pedal rod will contact the end of the master cylinder actuator rod and the system will apply the brakes without any power assistance. The driver will notice that much higher pedal effort is needed to stop the vehicle and that the pedal feels "harder" than usual.

Test for a system vacuum leak as described below:

1. Operate the engine at idle without touching the brake pedal for at least one minute.
2. Turn off the engine, and wait one minute.
3. Test for the presence of assist vacuum by depressing the brake pedal and releasing it several times. Light application will produce less and less pedal travel, if vacuum was present. If there is no vacuum, air is leaking into the system somewhere.

Test for system operation as follows:

1. Pump the brake pedal (with engine off) until the supply vacuum is entirely gone.
2. Put a light, steady pressure on the pedal.
3. Start the engine, and operate it at idle. If the system is operating, the brake pedal should fall toward the floor if constant pressure is maintained on the pedal.

BRAKE SYSTEM

Troubleshooting the Brake System

Problem	Cause	Solution
Low brake pedal (excessive pedal travel required for braking action.)	• Excessive clearance between rear linings and drums caused by inoperative automatic adjusters • Worn rear brakelining • Bent, distorted brakeshoes, front or rear • Air in hydraulic system	• Make 10 to 15 alternate forward and reverse brake stops to adjust brakes. If brake pedal does not come up, repair or replace adjuster parts as necessary. • Inspect and replace lining if worn beyond minimum thickness specification • Replace brakeshoes in axle sets • Remove air from system. Refer to Brake Bleeding.

9 BRAKES

Troubleshooting the Brake System (cont.)

Problem	Cause	Solution
Low brake pedal (pedal may go to floor with steady pressure applied.)	• Fluid leak in hydraulic system • Air in hydraulic system • Incorrect or non-recommended brake fluid (fluid evaporates at below normal temp). • Master cylinder piston seals worn, or master cylinder bore is scored, worn or corroded	• Fill master cylinder to fill line; have helper apply brakes and check calipers, wheel cylinders, differential valve tubes, hoses and fittings for leaks. Repair or replace as necessary. • Remove air from system. Refer to Brake Bleeding. • Flush hydraulic system with clean brake fluid. Refill with correct-type fluid. • Repair or replace master cylinder
Low brake pedal (pedal goes to floor on first application—o.k. on subsequent applications.)	• Disc brake pads sticking on abutment surfaces of anchor plate. Caused by a build-up of dirt, rust, or corrosion on abutment surfaces	• Clean abutment surfaces
Fading brake pedal (pedal height decreases with steady pressure applied.)	• Fluid leak in hydraulic system • Master cylinder piston seals worn, or master cylinder bore is scored, worn or corroded	• Fill master cylinder reservoirs to fill mark, have helper apply brakes, check calipers, wheel cylinders, differential valve, tubes, hoses, and fittings for fluid leaks. Repair or replace parts as necessary. • Repair or replace master cylinder
Decreasing brake pedal travel (pedal travel required for braking action decreases and may be accompanied by a hard pedal.)	• Caliper or wheel cylinder pistons sticking or seized • Master cylinder compensator ports blocked (preventing fluid return to reservoirs) or pistons sticking or seized in master cylinder bore • Power brake unit binding internally	• Repair or replace the calipers, or wheel cylinders • Repair or replace the master cylinder • Test unit according to the following procedure: (a) Shift transmission into neutral and start engine (b) Increase engine speed to 1500 rpm, close throttle and fully depress brake pedal (c) Slow release brake pedal and stop engine (d) Have helper remove vacuum check valve and hose from power unit. Observe for backward movement of brake pedal. (e) If the pedal moves backward, the power unit has an internal bind—replace power unit

Troubleshooting the Brake System (cont.)

Problem	Cause	Solution
Grabbing brakes (severe reaction to brake pedal pressure.)	• Brakelining(s) contaminated by grease or brake fluid • Parking brake cables incorrectly adjusted or seized • Incorrect brakelining or lining loose on brakeshoes • Caliper anchor plate bolts loose • Rear brakeshoes binding on support plate ledges • Incorrect or missing power brake reaction disc • Rear brake support plates loose	• Determine and correct cause of contamination and replace brakeshoes in axle sets • Adjust cables. Replace seized cables. • Replace brakeshoes in axle sets • Tighten bolts • Clean and lubricate ledges. Replace support plate(s) if ledges are deeply grooved. Do not attempt to smooth ledges by grinding. • Install correct disc • Tighten mounting bolts
Spongy brake pedal (pedal has abnormally soft, springy, spongy feel when depressed.)	• Air in hydraulic system • Brakeshoes bent or distorted • Brakelining not yet seated with drums and rotors • Rear drum brakes not properly adjusted	• Remove air from system. Refer to Brake Bleeding. • Replace brakeshoes • Burnish brakes • Adjust brakes
Hard brake pedal (excessive pedal pressure required to stop vehicle. May be accompanied by brake fade.)	• Loose or leaking power brake unit vacuum hose • Incorrect or poor quality brake-lining • Bent, broken, distorted brakeshoes • Calipers binding or dragging on mounting pins. Rear brakeshoes dragging on support plate. • Caliper, wheel cylinder, or master cylinder pistons sticking or seized • Power brake unit vacuum check valve malfunction	• Tighten connections or replace leaking hose • Replace with lining in axle sets • Replace brakeshoes • Replace mounting pins and bushings. Clean rust or burrs from rear brake support plate ledges and lubricate ledges with molydisulfide grease. NOTE: If ledges are deeply grooved or scored, do not attempt to sand or grind them smooth—replace support plate. • Repair or replace parts as necessary • Test valve according to the following procedure: (a) Start engine, increase engine speed to 1500 rpm, close throttle and immediately stop engine (b) Wait at least 90 seconds then depress brake pedal (c) If brakes are not vacuum assisted for 2 or more applications, check valve is faulty

9 BRAKES

Troubleshooting the Brake System (cont.)

Problem	Cause	Solution
Hard brake pedal (excessive pedal pressure required to stop vehicle. May be accompanied by brake fade.)	• Power brake unit has internal bind • Master cylinder compensator ports (at bottom of reservoirs) blocked by dirt, scale, rust, or have small burrs (blocked ports prevent fluid return to reservoirs). • Brake hoses, tubes, fittings clogged or restricted • Brake fluid contaminated with improper fluids (motor oil, transmission fluid, causing rubber components to swell and stick in bores • Low engine vacuum	• Test unit according to the following procedure: (a) With engine stopped, apply brakes several times to exhaust all vacuum in system (b) Shift transmission into neutral, depress brake pedal and start engine (c) If pedal height decreases with foot pressure and less pressure is required to hold pedal in applied position, power unit vacuum system is operating normally. Test power unit. If power unit exhibits a bind condition, replace the power unit. • Repair or replace master cylinder CAUTION: Do not attempt to clean blocked ports with wire, pencils, or similar implements. Use compressed air only. • Use compressed air to check or unclog parts. Replace any damaged parts. • Replace all rubber components, combination valve and hoses. Flush entire brake system with DOT 3 brake fluid or equivalent. • Adjust or repair engine
Dragging brakes (slow or incomplete release of brakes)	• Brake pedal binding at pivot • Power brake unit has internal bind • Parking brake cables incorrectly adjusted or seized • Rear brakeshoe return springs weak or broken • Automatic adjusters malfunctioning • Caliper, wheel cylinder or master cylinder pistons sticking or seized • Master cylinder compensating ports blocked (fluid does not return to reservoirs).	• Loosen and lubricate • Inspect for internal bind. Replace unit if internal bind exists. • Adjust cables. Replace seized cables. • Replace return springs. Replace brakeshoe if necessary in axle sets. • Repair or replace adjuster parts as required • Repair or replace parts as necessary • Use compressed air to clear ports. Do not use wire, pencils, or similar objects to open blocked ports.
Vehicle moves to one side when brakes are applied	• Incorrect front tire pressure • Worn or damaged wheel bearings	• Inflate to recommended cold (reduced load) inflation pressure • Replace worn or damaged bearings

Troubleshooting the Brake System (cont.)

Problem	Cause	Solution
Vehicle moves to one side when brakes are applied	• Brakelining on one side contaminated • Brakeshoes on one side bent, distorted, or lining loose on shoe • Support plate bent or loose on one side • Brakelining not yet seated with drums or rotors • Caliper anchor plate loose on one side • Caliper piston sticking or seized • Brakelinings water soaked • Loose suspension component attaching or mounting bolts • Brake combination valve failure	• Determine and correct cause of contamination and replace brakelining in axle sets • Replace brakeshoes in axle sets • Tighten or replace support plate • Burnish brakelining • Tighten anchor plate bolts • Repair or replace caliper • Drive vehicle with brakes lightly applied to dry linings • Tighten suspension bolts. Replace worn suspension components. • Replace combination valve
Chatter or shudder when brakes are applied (pedal pulsation and roughness may also occur.)	• Brakeshoes distorted, bent, contaminated, or worn • Caliper anchor plate or support plate loose • Excessive thickness variation of rotor(s)	• Replace brakeshoes in axle sets • Tighten mounting bolts • Refinish or replace rotors in axle sets
Noisy brakes (squealing, clicking, scraping sound when brakes are applied.)	• Bent, broken, distorted brakeshoes • Excessive rust on outer edge of rotor braking surface	• Replace brakeshoes in axle sets • Remove rust
Noisy brakes (squealing, clicking, scraping sound when brakes are applied.) (cont.)	• Brakelining worn out—shoes contacting drum of rotor • Broken or loose holdown or return springs • Rough or dry drum brake support plate ledges • Cracked, grooved, or scored rotor(s) or drum(s) • Incorrect brakelining and/or shoes (front or rear).	• Replace brakeshoes and lining in axle sets. Refinish or replace drums or rotors. • Replace parts as necessary • Lubricate support plate ledges • Replace rotor(s) or drum(s). Replace brakeshoes and lining in axle sets if necessary. • Install specified shoe and lining assemblies
Pulsating brake pedal	• Out of round drums or excessive lateral runout in disc brake rotor(s)	• Refinish or replace drums, re-index rotors or replace

CAUTION

Brake pads and shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

Adjustment DISC BRAKES

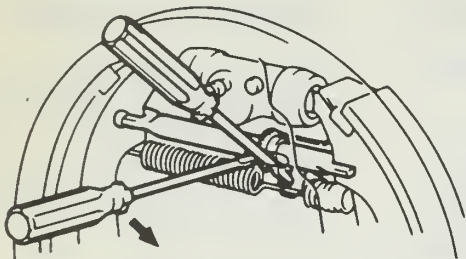
All disc brakes are inherently self-adjusting. No periodic adjustment is either necessary or possible.

9 BRAKES

DRUM BRAKES

NOTE: Toyota trucks utilize self-adjusting brakes. The following procedure is necessary only after the brake shoes have been changed.

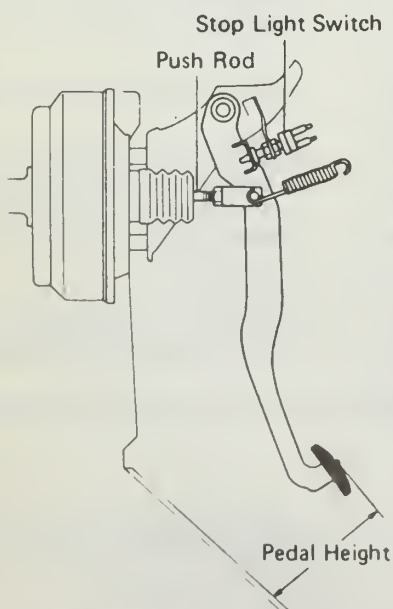
1. Place blocks under the front wheels so that the truck will not roll forward when it is jacked up at the rear.
2. Fully release the emergency brake.
3. Raise the rear of the truck and support the differential housing with jackstands.
4. Remove the plug from the adjusting hole at the bottom of the backing plate.
5. Turn the adjusting starwheel to expand the shoes fully. While doing this, have a friend step on the brake pedal occasionally to center the shoes.



Rear drum brakes may be adjusted manually if necessary

6. Tighten the shoes until the wheel will not turn when the pedal is released.
7. From this position back off the adjuster until the wheel turns with just a slight drag.
8. Back off the adjuster an additional five notches. The wheel should turn smoothly. If it does not, back off another two or three notches. Should this fail, check for worn or defective parts.
9. Adjust the other wheel in the same manner.

BRAKE PEDAL



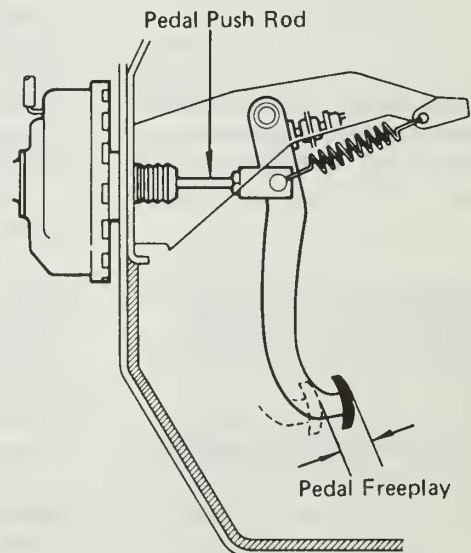
Pedal height is measured from the floor pad, not the carpet

Pedal Height

1. Measure the distance between the center (upper surface) of the pedal pad and the floor pad, not the carpet.
 2. If out of specifications, loosen the brake light switch.
 3. Loosen the locknut and turn the pedal pushrod until the pedal height is within specifications:
 - 2WD Truck: 148mm (5.83 inches)
 - 4WD Truck: 145mm (5.71 inches)
 - 4Runner: 145–150mm (5.71–5.91 inches)
 - 1989–90 Land Cruiser: 161–171mm (6.34–6.73 inches)
 - 1991 Land Cruiser: 180mm (7.09 inches)
- Tighten the pushrod locknut.
4. Move the brake light switch until the plunger is just touching the pedal stopper. Tighten the switch.
 5. Check the brake pedal free-play.

Free-play

1. With the engine turned off, depress the brake pedal several times until there is no vacuum left in the brake booster.
2. Push the pedal down until resistance is first felt. Measure this distance; it should be 3–6mm (0.12–0.24 inches).



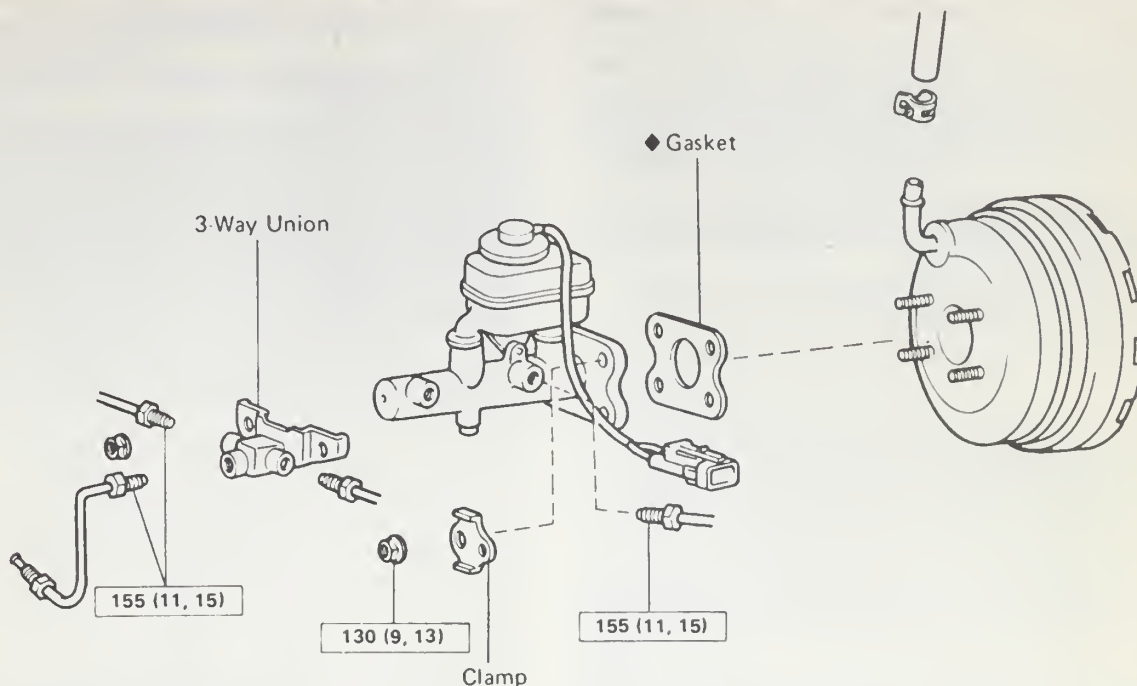
Pedal freeplay is the amount of motion before the brakes apply

3. Adjust the free-play by turning the pedal pushrod.
4. Start the engine and recheck the free-play.
5. Recheck the pedal height.

Brake Light Switch

REMOVAL AND INSTALLATION

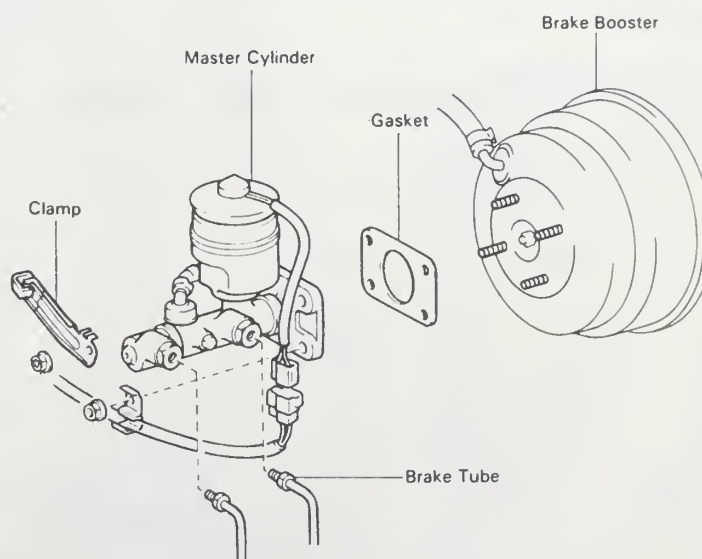
1. Disconnect the electrical harness at the switch.
2. Remove the lock nut (closest to the pedal). Remove the switch from the brake pedal.
3. Insert the new switch and loosely install the locknut. Adjust the switch so that plunger at the tip of the switch is held in by the pedal in its at-rest position. Remember that the pedal holds the switch OFF; the brake lamps come on when the pedal moves away from the switch.
4. Once positioned, tighten the lock nut and connect the wiring. Check the switch function by pressing the pedal; have an assistant observe the brake lamps.



kg-cm (ft-lb, N-m) : Specified torque

◆ Non-reusable part

Master cylinder — Truck and 4Runner



Master cylinder — Land Cruiser

Master Cylinder REMOVAL AND INSTALLATION

Be careful not to spill brake fluid on the painted surfaces. It will damage the paint. If a spill occurs, flush the area with plenty of fresh water.

1. Disconnect the fluid level warning switch connector.

2. Use a syringe or similar tool to remove as much fluid as possible from the reservoir.

3. Carefully disconnect the brake lines at the master cylinder. To prevent line damage, use either tool 09751-36011 or a line wrench. Regular open-end wrenches are NOT recommended. Take great care not to bend or deform the lines.

4. Remove the four nuts holding the master cylinder to the booster. On Trucks and 4Runners, unbolt the 3-way union.

9 BRAKES

When removing the cylinder, take care to recover the clamps, gaskets, etc.

5. Install the master cylinder and gasket onto the brake booster. Tighten the four nuts to 9 ft. lbs. (13 Nm).

6. Attach the 3-way union if it was removed. Carefully connect the brake tubes, initially threading them into place by hand. Once properly engaged, tighten the fittings to 11 ft. lbs. (15 Nm).

7. Connect the wiring harness for the brake fluid switch.

8. Fill the brake fluid reservoir with fluid to the MAX line. Check the leakage.

9. Bleed the brake system. Check again for any leakage.

10. Check and adjust the brake pedal.

OVERHAUL

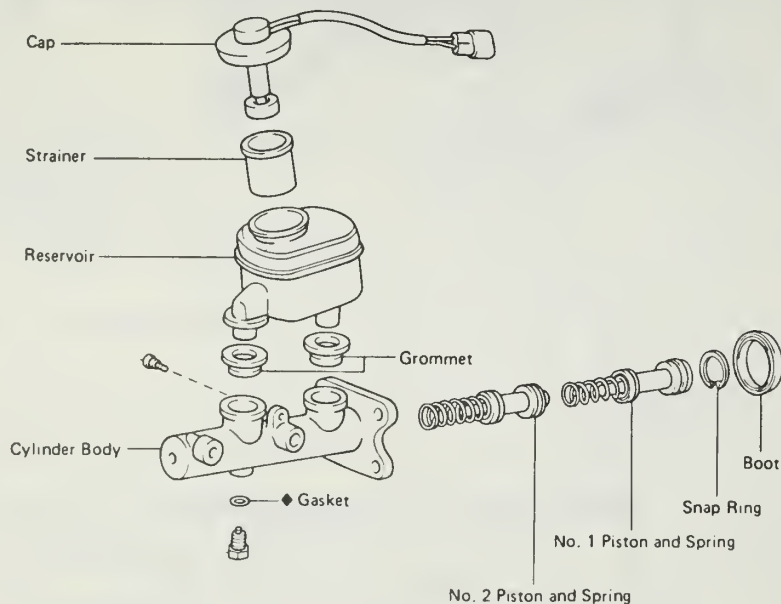
1. Mount the cylinder in a vise. Remove the boot from the end of the master cylinder.

2. Remove the set screw holding the reservoir on Truck and 4Runner units and remove the reservoir. On Land Cruiser, slide the clamp up the hose toward the reservoir, remove the set bolt and remove the reservoir with the hose from the cylinder.

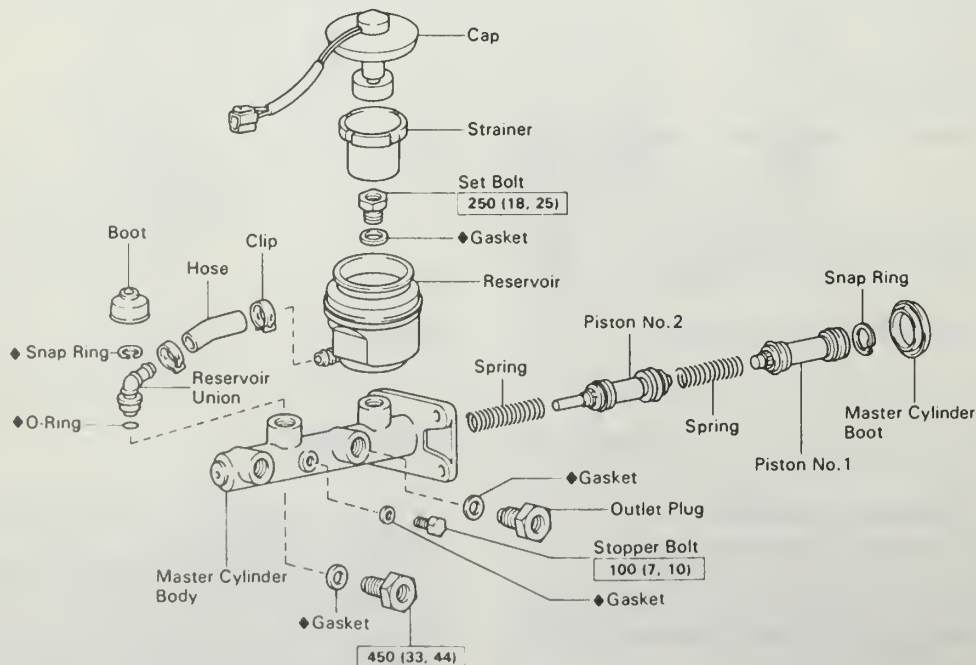
3. Remove the two grommets. On Land Cruiser, remove the snapping holding the reservoir union and remove the union.

4. On Land Cruiser, remove the two outlet plugs from the side of the cylinder.

5. Place tape over the blade of a screwdriver. Use this tool to



Master cylinder components — Truck and 4Runner



Master cylinder components — Land Cruiser

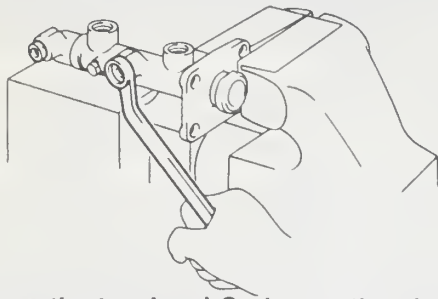
push the master cylinder piston all the way in and remove piston stopper bolt and washer.

6. Push the piston in and remove the snapping with snapping pliers.

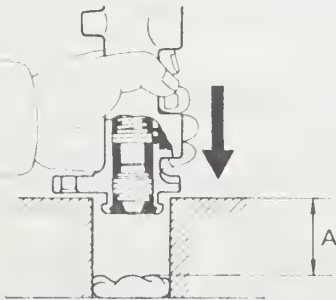
7. Remove the No. 1 piston and spring by hand, pulling the piston straight out. If pulled at an angle, the cylinder bore may be damaged.

8. Place a rag and 2 wooden blocks on the work bench. Remove the cylinder from the vise and lightly tap the cylinder flange against the wood block until the No.2 piston slides out.

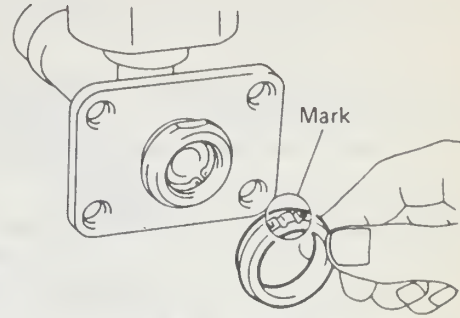
9. After washing all parts in clean brake fluid, dry them with compressed air (if available). Drying parts with a shop rag can deposit lint and dirt particles inside the assembled master cylinder. Inspect the cylinder bore for wear, scuff marks, or nicks. Cylinders may be cleaned but should not be honed. In view of the importance of the master cylinder, it is recommended that it



Remove the two Land Cruiser outlet plugs



Removing the second piston. Distance "A" should be about 4 in. (101.6mm)



Make sure the mark is up when installing the boot

is replaced rather than overhauled if worn or damaged.

10. Coat all parts with clean brake fluid prior to assembly or, if available, coat them with lithium soap based glycol grease.

11. Install the two pistons and springs straight into the bore. Be careful not to damage the rubber lips on the pistons.

12. Use the padded screwdriver to push the pistons forward; install the snapping.

13. Push the pistons all the way forward; install the piston stopper bolt with a new gasket. Tighten the bolt to 7 ft. lbs. (10 Nm).

14. On Land Cruiser, install the outlet plugs and tighten them to 33 ft. lbs. (44 Nm).

15. Install the reservoir. For Land Cruiser, coat the O-ring and base of the union with either brake fluid or lithium soap based glycol grease.

16. Tighten the reservoir retaining bolt. On trucks and 4Runner, tighten it to 15.2 inch lbs. (1.7 Nm); for Land Cruiser, tighten it to 18 ft. lbs. (25 Nm).

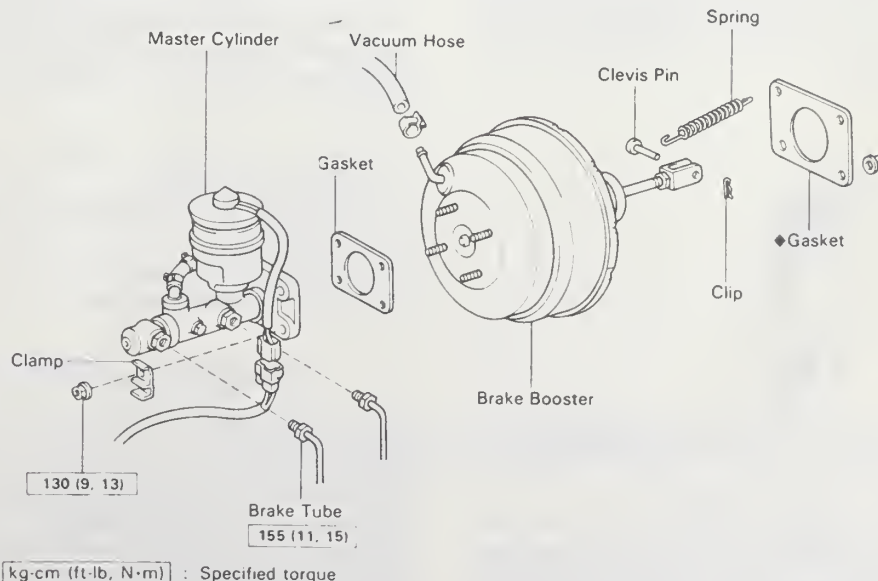
17. Install the boot, making sure the mark on the boot is UP.

Power Brake Booster

REMOVAL AND INSTALLATION

1. Remove the master cylinder.

2. At the brake pedal, remove the clip and separate the clevis from the pedal.



Land Cruiser brake booster; others similar

9 BRAKES

3. Disconnect the vacuum hose from the booster.
4. Loosen the four nuts and then pull out the vacuum booster, the bracket and the gasket.

NOTE: Some truck models employ a spacer and additional gaskets at the firewall.

5. Install the booster and tighten the mounting bolts to 9 ft. lbs. (13 Nm).
6. Connect the clevis rod to the brake pedal.
7. Install the master cylinder. Check the brake pedal adjustment and bleed the brakes.

Load Sensing Proportioning and Bypass Valve

The purpose of this valve is to control the fluid pressure applied to the brakes to prevent rear wheel lock-up during weight transfer at high speed stops.

REMOVAL AND INSTALLATION

1. Disconnect the brake lines going to the valve.
2. Remove the mounting bolt, if used, and remove the valve.

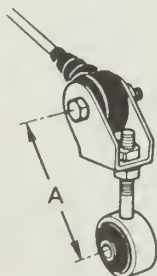
NOTE: This valve can not be rebuilt. It must be replaced.

3. Installation is the reverse of removal.
4. Bleed the brake system.

ADJUSTMENT

1. Pull down the load sensing spring to determine that the piston moves slowly.
2. Set the valve body so that the piston lightly touches the load sensing spring.
3. Tighten the mounting bolts.
4. If the pressure to the rear brakes needs to be adjusted without the use of pressure gauges, adjust the length of the No. 2 shackle. Lengthening the distance between the centers lowers the pressure; shortening the distance raises the pressure. One full turn of the nut increases pressure about 20 psi. on Land Cruiser or about 14 psi on Trucks and 4Runners.

Initial length of this link (distance A) should be 90mm (3.54 inches) on Truck and 4Runner or 78mm (3.07 inches) on Land Cruiser. If the initial distance is correct, fluid metering should be very close to specification.



Distance A determines the adjustment of pressure at the load sensing proportioning and bypass valve

NOTE: There is a very precise method of adjustment for this valve requiring the use of pressure gauges hooked into the brake lines. Since it also requires determining the exact weight of the load on the rear axle during the test, it is not practical for the owner/mechanic.

Brake Hoses and Lines

REMOVAL AND INSTALLATION

Metal lines and rubber brake hoses should be checked frequently for leaks and external damage. Metal lines and particularly prone to crushing and kinking under the vehicle. Any such deformation can restrict the proper flow of fluid and therefore impair braking at the wheels. Rubber hoses should be checked for cracking or scraping; such damage can create a weak spot in the hose and it could fail under pressure.

Any time the lines are removed or disconnected, extreme cleanliness must be observed. The slightest bit of dirt in the system can plug a fluid port and render the brakes defective. Clean all joints and connections before disassembly (use a stiff brush and clean brake fluid) and plug the lines and ports as soon as they are opened. New lines and hoses should be blown or flushed clean before installation to remove any contamination. To replace a line or hose:

1. Elevate and safely support the vehicle on stands.
 2. Remove wheel(s) as necessary for access.
 3. Clean the surrounding area on the joints to be disconnected.
 4. Place a catch pan under the joint to be disconnected. To reduce fluid spillage during the repair, either plug the vent hole in the reservoir cap or substitute a cap with no vent hole.
 5. Using two wrenches—one to hold the joint and one to turn the fitting—disconnect the hose or line to be replaced.
 6. Disconnect the other end of the line or hose, moving the drain pan if necessary. Always use two wrenches.
 7. Disconnect any retaining clips or brackets holding the line and remove the line.
 8. If the system is to remain open for more time than it takes to swap hoses, tape or plug each remaining line and port to keep dirt out and fluid in.
 9. Install the new line or hose, starting the end farthest from the master cylinder first. Connect the other end and confirm that both fittings are correctly threaded and turn smoothly with the fingers.
- Make sure the new line will not rub against any other part. Brake lines must be at least ½ inch from the steering column and other moving parts. Any protective shielding or insulators must be reinstalled in the original location.

NOTE: If the new metal line requires bending, do so gently using a pipe bending tool. Do not attempt to bend the tubing by hand; it will kink the pipe and render it useless.

10. Using two wrenches as before, tighten each fitting to 13–17 Nm or 9–12 ft. lbs.
11. Install any retaining clips or brackets on the lines.
12. Refill the brake reservoir and replace the unvented cap if one was substituted.
13. Bleed the brake system.
14. Install the wheels and lower the vehicle to the ground.

Bleeding the Brake System

It is necessary to bleed the hydraulic system any time the system has been opened or has trapped air within the fluid lines. It may be necessary to bleed the system at all four brakes if air has been introduced through a low fluid level or by disconnecting brake pipes at the master cylinder.

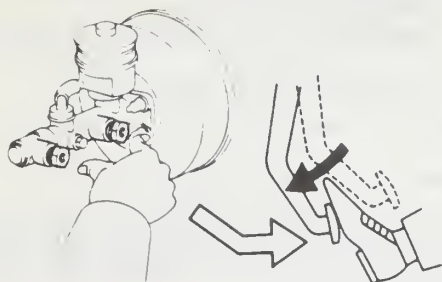
If a line is disconnected at one wheel only, generally only that brake needs bleeding. If lines are disconnected at any fitting between the master cylinder and the brake, the system served by the disconnected pipe must be bled.

WARNING: Do not allow brake fluid to splash or spill onto painted surfaces; the paint will be damaged. If spillage occurs, flush the area immediately with clean water.

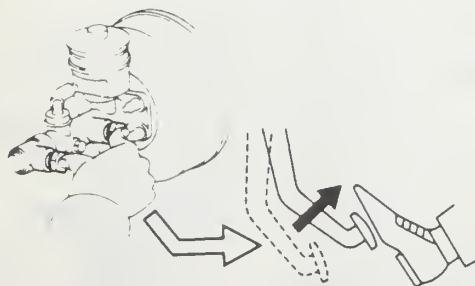
BLEEDING THE MASTER CYLINDER

If the master cylinder has been removed, the lines disconnected or the reservoir allowed to run dry, the cylinder must be bled before the lines are bled. To bleed the master cylinder:

1. Disconnect the brake lines from the master cylinder.
2. Place a pan or rags under the cylinder.
3. Have an assistant slowly depress the brake pedal and hold it down.
4. Block off the outlet ports with your fingers; have the assistant release the pedal. Make a tight seal with your fingers; do



When bleeding the master cylinder, depress the pedal and hold it down.



Block the brake line ports with your fingers and release the pedal. Do this 3 or 4 times



Bleeding the brakes requires pumping the pedal slowly and holding it

not allow the cylinder to ingest air when the pedal is released.

5. Repeat Steps 3 and 4 three or four times.
6. Connect the brake lines to the master cylinder and top up the fluid reservoir.

BLEEDING LINES AND WHEEL CIRCUITS

1. Insert a clear vinyl tube onto the bleeder plug at the wheel. If all four wheels are to be bled, begin with the right rear.

2. Insert the other end of the tube into a jar which is half filled with brake fluid. Make sure the end is submerged in the fluid.

3. Have an assistant slowly pump the brake pedal several times. On the last pump, have the assistant hold the pedal fully depressed. While the pedal is depressed, open the bleeder plug until fluid starts to run out, then close the plug.

NOTE: If the brake pedal is pumped too fast, small air bubbles will form in the brake fluid which will be very difficult to remove.

4. Repeat this procedure until no air bubbles are visible in the hose. Close the bleeder port.

NOTE: Constantly replenish the brake fluid in the master cylinder reservoir, so that it does not run out during bleeding.

5. If bleeding the entire system, repeat the procedure at the left rear wheel, the right front wheel and the left front wheel in that order.

6. Bleed the load sensing proportioning and by-pass valve.

FRONT DISC BRAKES

CAUTION

Brake shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from any brake surface. When cleaning brake surfaces, use a commercially available brake cleaning fluid.

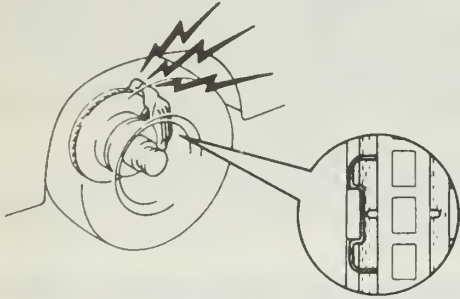
Disc Brake Pads

WEAR INDICATORS

The front disc brake pads are equipped with a metal tab which will come into contact with the disc after the friction surface

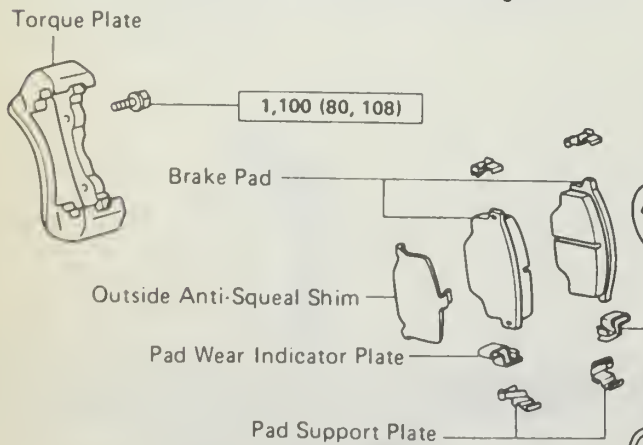
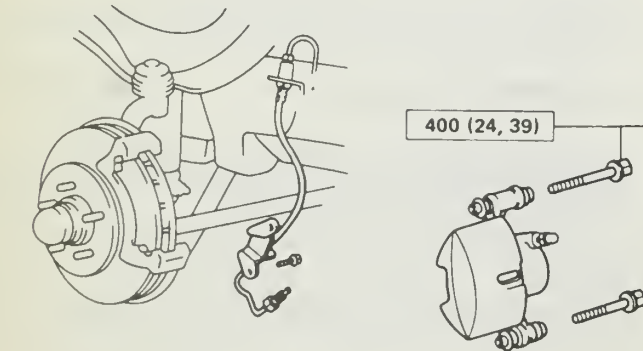
9 BRAKES

material has worn near its usable minimum. The wear indicators make a constant, distinct metallic sound that should be easily heard. (The sound has been described as similar to either fingernails on a blackboard or a field full of crickets.) The key to recognizing that it is the wear indicators and not some other brake noise is that the sound is heard when the vehicle is being driven **WITHOUT** the brakes applied. It may or may not be present under braking and is heard during normal driving.



The wear indicators make a distinct noise when the tabs hit the brake disc

It should also be noted that any disc brake system, by its design, cannot be made to work silently under all conditions. Each system includes various shims, plates, cushions and brackets to suppress brake noise, but no system can completely silence all noises. Some brake noise—either high or low frequency—can be controlled and perhaps lessened, but cannot be totally eliminated.



kg-cm (ft-lb, N-m) : Specified torque
◆ Non-reusable part

INSPECTION

The front brake pads may be inspected without removal. With the front end elevated and supported, remove the wheel(s). Unlock the steering column lock and turn the wheel so that the brake caliper is out from under the fender.

View the pads—inner and outer—through the cut-out in the center of the caliper. Remember to look at the thickness of the pad friction material (the part that actually presses on the disc) rather than the thickness of the backing plate which does not change with wear.

Keep in mind that you are looking at the profile of the pad, not the whole thing. Brake pads can wear on a taper which may not be visible through the window. It is also not possible to check the contact surface for cracking or scoring from this position. This quick check can be helpful only as a reference; detailed inspection requires pad removal.

REMOVAL AND INSTALLATION

2WD Truck w/PD60 or 66-Type Brakes

1. Jack up the front of the truck and safely support it with jackstands.
2. Remove the lug nuts and the wheel.
3. Remove the lower installation bolt from the torque plate. The torque plate is the framework that holds the caliper.
4. Pivot the caliper assembly upwards and suspend it from the suspension with a wire. Do **NOT** disconnect the brake line, but take care not to stretch it.
5. Remove the 2 anti-squeal springs and lift out the brake pads.

PD66 Type

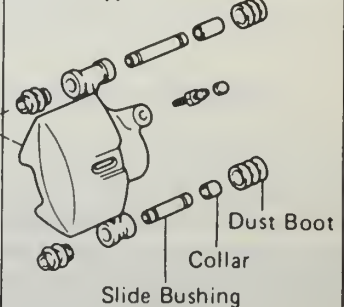
Inside Anti-Squeal Shim



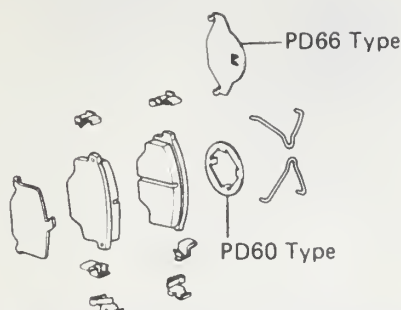
Inside Anti-Squeal Shim (PD60 Type)

Anti-Squeal Spring

PD60 Type



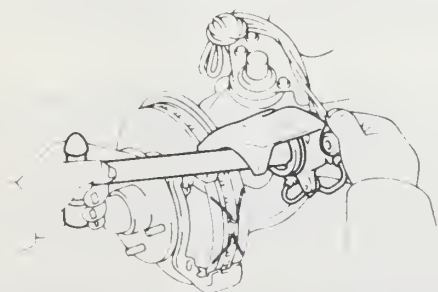
PD 60 and 66 type brake components



After raising and supporting the caliper, remove the pads, shims and plates



Install the pad support plates



Carefully push the piston into the caliper before lowering the caliper

6. Remove the 2 anti-squeal shims and the 4 pad support plates. Pull the 2 pad wear indicator off the pads.
7. Check the pad thickness and replace the pads if they are less than 1mm thick. New pads measure approximately 9.6mm thick.

NOTE: This minimum thickness measurement may disagree with your state inspection laws.

To install:

8. Install the 4 pad support plates into the torque plate.
9. Install a new pad wear indicator plate to each pad.
10. Install the large anti-squeal shim to the back of the outer

pad (PD 60) or to the back of each pad (PD 66) and then position both pads into the torque plate. Install the anti-squeal springs in place.

NOTE: When installing new brake pads, make sure your hands are clean. Do not allow any grease or oil to touch the contact face of the pads or the brakes will not stop the truck properly.

11. Remove a small amount of fluid from the reservoir, using a syringe or similar tool. Use a C-clamp or hammer handle and press the caliper piston back into the housing.

NOTE: Never press the piston into the caliper when the pads are out on both sides of the truck. The opposite piston will pop completely out of the caliper. This will spoil your afternoon.

12. For PD 60 types, press the round anti-squeal shim over the caliper piston; position the caliper over the torque plate so the dust boot is not pinched.

13. Swing the caliper down and fit the lower bolt. Tighten it to 29 ft. lbs. (39 Nm).

14. Install the wheel and lower the truck. Check the brake fluid level in the reservoir and fill to the max line if necessary. (The level should have risen when the piston was pushed back.)

15. Apply the parking brake and put the vehicle in PARK or Neutral. Step on the brake pedal two or three times. The first pedal application will be "long" due to the pistons being pushed back. The pedal travel should be normal after two or three pumps. Do NOT drive the vehicle until the pedal has a normal feel. If necessary, bleed the brakes to remove pedal sponginess.

NOTE: Braking should be moderate for the first 5 miles or so until the new pads seat correctly. The new pads will bed best if put through several moderate heating and cooling cycles. Avoid hard braking until the brakes have experienced several long, slow stops with time to cool in between. Taking the time to properly bed the brakes will yield quieter operation, more efficient stopping and contribute to extended brake life.

2WD Truck w/FS17 or 18-Type Brakes

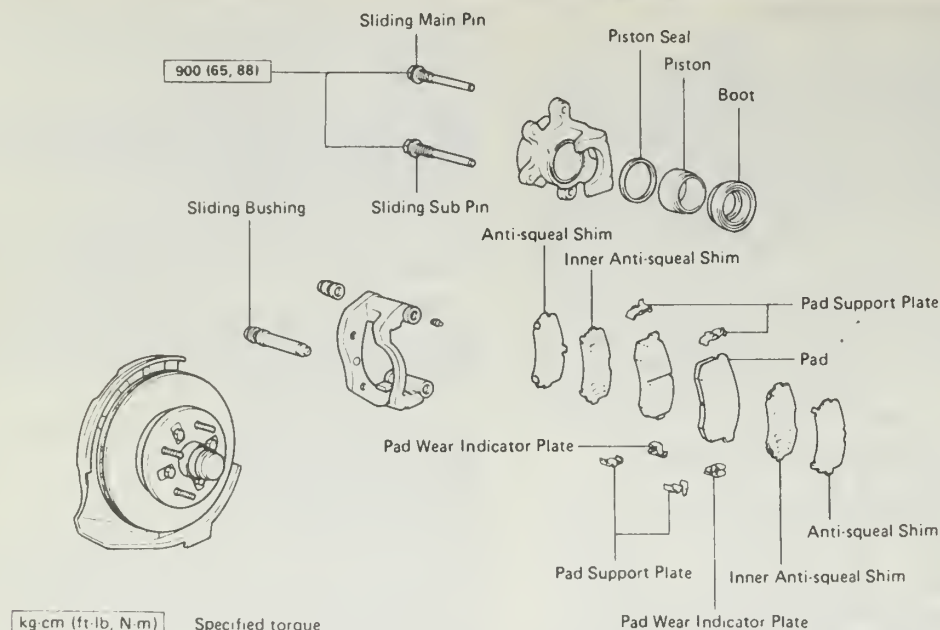
1. Remove the hub cap and loosen the lug nuts.
2. Jack up the front of the truck and safely support it with jackstands.
3. Remove the lug nuts and the wheel.
4. Remove the caliper slide pin on the sub-pin (lower) side.
5. Swivel the caliper up and away from the torque plate. Tie the caliper to a suspension member so it is out of the way. Do not disconnect the brake line.
6. Lift the 2 brake pads out of the torque plate. Remove the anti-squeal shim.
7. Remove the 4 pad support plates. Pull the 2 pad wear indicator plates off the pads.
8. Check the pad thickness and replace the pads if they are less than 1mm thick. New pads measure approximately 9.6mm thick.

NOTE: This minimum thickness measurement may disagree with your state inspection laws.

To install:

9. Install the 4 pad support plates into the torque plate.
10. Install a new pad wear indicator plate to the bottom of each pad.
11. Install the anti-squeal shim to the back of the outer pad and then position both pads into the torque plate.

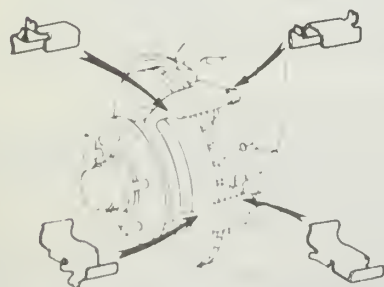
9 BRAKES



FS 17 or 18 type brake components



FS 17 and 18 pads, shims and supports



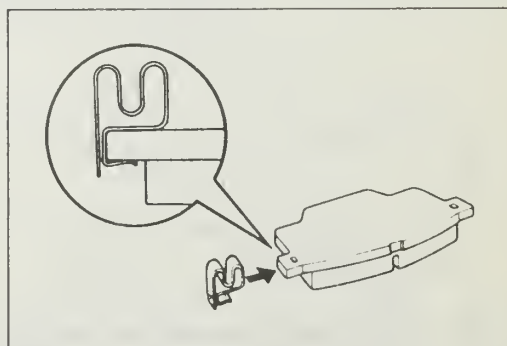
Location of pad support plates

CAUTION

When installing new brake pads, make sure your hands are clean. Do not allow any grease or oil to touch the contact face of the pads or the brakes will not stop the truck properly.

12. Use a syringe or similar tool to remove some fluid from the reservoir. Use a C-clamp or hammer handle and press the caliper piston back into the housing.

NOTE: Never press the piston into the caliper when the pads are out on both sides of the truck. The opposite piston will pop out of the caliper. This will spoil your afternoon.



Installation of the wear indicators on FS 17 or 18 pads

13. Untie the caliper and swivel it back into position over the torque plate so that the dust boot is not pinched. Install the slide pin and tighten it to 65 ft. lbs. (88 Nm).

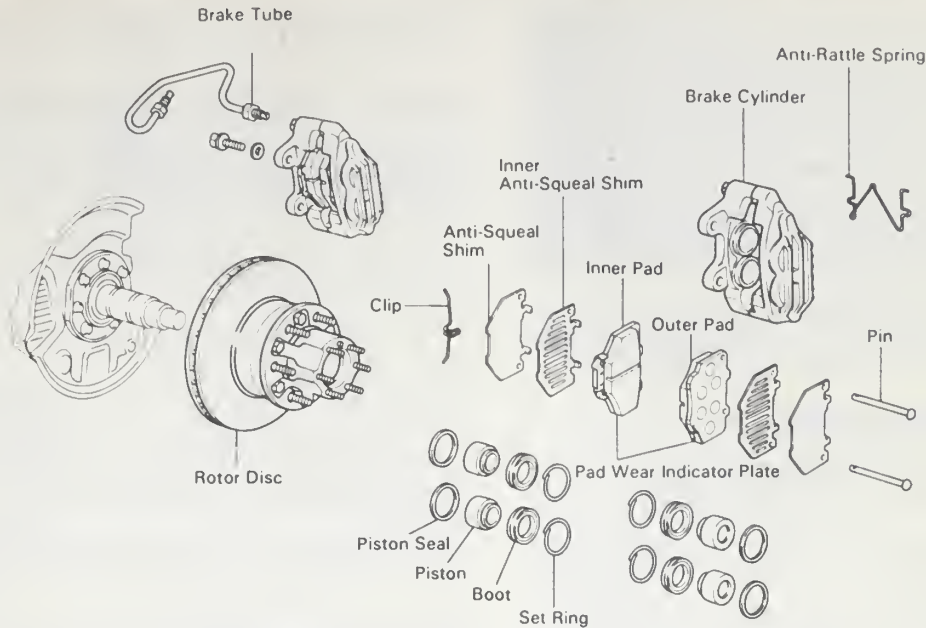
14. Check the condition of the cylinder side bushing boot.

15. Install the wheel and lower the truck.

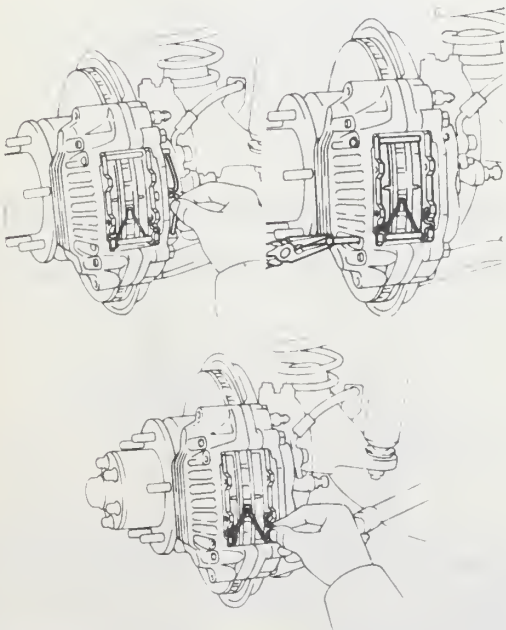
16. Check the brake fluid level in the reservoir and fill to the max line if necessary. (The level should have risen when the piston was pushed back.)

17. Apply the parking brake and put the vehicle in PARK or Neutral. Step on the brake pedal two or three times. The first pedal application will be "long" due to the pistons being pushed back. The pedal travel should be normal after two or three pumps. Do NOT drive the vehicle until the pedal has a normal feel. If necessary, bleed the brakes to remove pedal sponginess.

NOTE: Braking should be moderate for the first 5 miles or so until the new pads seat correctly. The new pads will bed best if put through several moderate heating and cooling cycles. Avoid hard braking until the brakes have experienced several long, slow stops with time to cool in between. Taking the time to properly bed the brakes will yield quieter operation, more efficient stopping and contribute to extended brake life.



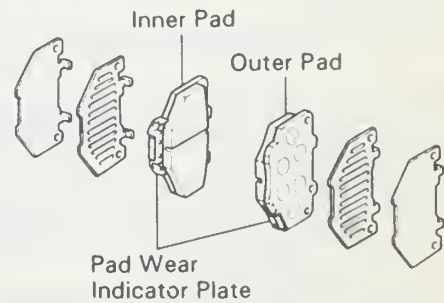
4WD front brake components. 1991 Land Cruiser shown, others similar



Remove the pin clip, the pins and the anti-rattle spring

4WD Truck, 4Runner and Land Cruiser

1. Jack up the front of the truck, support it on jackstands, and remove the front wheel.
2. Pull out the wire clip at the ends of the pad pins.
3. Remove the pins. Remove the anti-rattle spring (W-shaped, over the back of the pads), the brake pads and the four anti-squeal shims.
4. Check the pad thickness and replace the pads if they are less than 1mm thick. New pads measure approximately 9.6mm thick.



Arrangement of 4WD pads and shims

NOTE: This minimum thickness measurement may disagree with your state inspection laws.

5. Check the pins for straightness and wear, and replace if necessary.

To install:

6. Use a syringe or similar tool to remove a small amount of fluid from the master cylinder reservoir.
7. Use a C-clamp or hammer handle and press the caliper pistons back into the housing.

NOTE: Never press the pistons into the caliper when the pads are out on both sides of the truck.

9. On Truck and 4Runner, install the 4 anti-squeal shims so that the black shims are between the silver shims and the brake pad.
10. Install the brake pads. Be very careful not to get grease or oil on the inner surfaces of the pads.
11. Install the anti-rattle spring.
12. Slide the 2 pad retaining pins through the caliper and pads and install the retaining clip.
13. Install the wheel and lower the truck. Bleed the brakes and road test the vehicle.
14. Check the brake fluid level in the reservoir and fill to the max line if necessary. (The level should have risen when the piston was pushed back.).

9 BRAKES

15. Apply the parking brake and put the vehicle in PARK or Neutral. Step on the brake pedal two or three times. The first pedal application will be "long" due to the pistons being pushed back. The pedal travel should be normal after two or three pumps. Do NOT drive the vehicle until the pedal has a normal feel. If necessary, bleed the brakes to remove pedal sponginess.

NOTE: Braking should be moderate for the first 5 miles or so until the new pads seat correctly. The new pads will bed best if put through several moderate heating and cooling cycles. Avoid hard braking until the brakes have experienced several long, slow stops with time to cool in between. Taking the time to properly bed the brakes will yield quieter operation, more efficient stopping and contribute to extended brake life.

Brake Caliper

REMOVAL AND INSTALLATION

4WD Vehicles

1. Jack up the front of the truck, support it on jackstands, and remove the front wheel.
2. Pull out the two wire clips at the ends of the pad pins.
3. Pull out the pads and anti-rattle spring.
4. Remove the brake pads. On 4WD trucks and 4Runners, lift out the anti-squeal shims.
5. Plug the vent hole on the master cylinder cap to prevent fluid leak. Unbolt the brake line from the caliper, being careful not to deform the fittings.
6. Remove the 2 caliper mounting bolts, and remove the caliper.

To install:

7. Position the caliper and install the mounting bolts. Tighten the caliper mounting bolts to 90 ft. lbs. (123 Nm). Be certain to position the shims correctly.
8. Connect the brake line to the caliper. For Trucks, 4Runners and 1989-90 Land Cruisers, tighten the line fitting to 11 ft. lbs. (15 Nm). For 1991 Land Cruisers, tighten it to 22 ft. lbs. (30 Nm).
9. Install the brake pads.
10. Install the wheel and lower the truck. Bleed the brakes and road test the vehicle.

2WD Trucks

1. Elevate and safely support the vehicle.
2. Remove the wheel.
3. Disconnect the brake line from the caliper.
4. Remove the bolts holding the caliper to the torque plate.
5. Remove the caliper.
6. Remove the pads and shims.

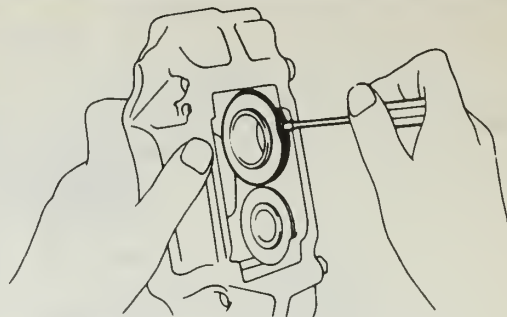
To install:

7. Install the pads and shims.
8. Fit the caliper into position. Install the two retaining or slide bolts. On trucks with FS 17 or 18 brakes, tighten the bolts to 65 ft. lbs. (88 Nm); on trucks with PD 60 or 66 brakes, tighten the bolts to 29 ft. lbs. (39 Nm).
9. Install the brake line, tightening the fitting to 11 ft. lbs. (15 Nm).
10. Install the wheel.
11. Lower the vehicle to the ground. Bleed the brakes and road test the vehicle.

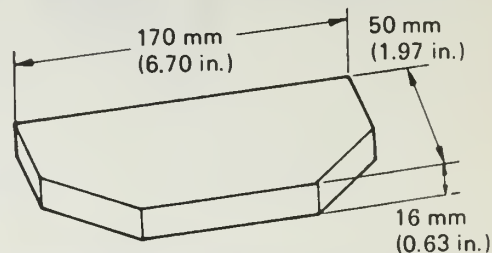
OVERHAUL

4WD Truck, 4Runner and Land Cruiser

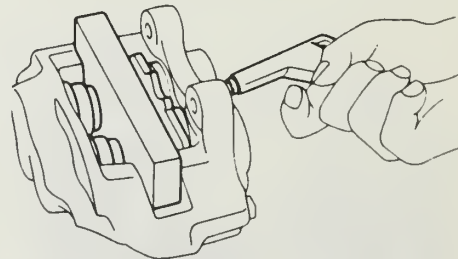
1. Raise the front of the truck and support with safety stands. Remove the wheels.



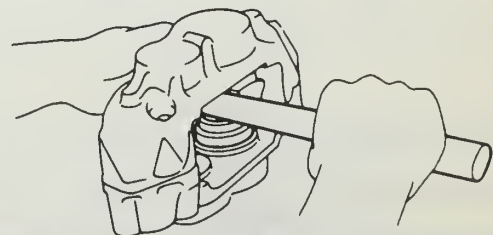
Remove the caliper piston set ring



For 4-piston calipers, fabricate a wooden block to fit between the pistons



Use compressed air to force the pistons free



Make sure the piston is square to the bore before installing

2. Remove the caliper.
3. Carefully pry the dust boot set ring out of the caliper. Remove the dust boot.
4. Insert a piece of wood about 1/2 in. thick between the caliper pistons.
5. Apply compressed air to the brake line union to force the piston out of its bore. Be careful; the piston will come out forcefully.

CAUTION

Keep fingers away from the front of the piston during removal. Injury may occur when the piston comes out.

6. Remove the piston seal from the caliper cylinder bore. Check the piston and cylinder bore for wear and/or corrosion. Replace components as necessary.

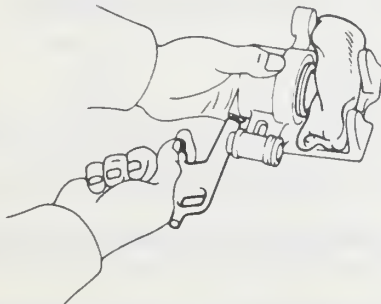
WARNING: Do not loosen the four bolts holding the two halves of the caliper together.

To assemble:

7. Coat all components with clean brake fluid or lithium soap based glycol grease.
8. Install the piston seal and then the piston into the caliper cylinder bore. Seat the piston in the bore with your fingers.
9. Fit the boot into the groove in the cylinder bore and press in the set ring.
10. Install the caliper and brake pads.
11. Install the wheels and lower the truck. Bleed the brakes and road test the vehicle.

2WD Truck

1. Raise the front of the truck and support with safety stands. Remove the wheels.
2. Remove the caliper.
3. Remove the slide bushing (2 on PD60), 2 pin dust boots (4 on PD60) and 2 collars (PD60 only).
4. Carefully pry the dust boot set ring out of the caliper. Remove the dust boot.
5. Insert a piece cloth or rag between the caliper claw and the piston.



Keep fingers out of the way of the escaping piston



Install the piston seal and install the piston

6. Apply compressed air to the brake line union to force the piston out of its bore. Be careful; the piston may come out forcefully.

CAUTION

Keep fingers away from the front of the piston during removal. Injury may occur when the piston comes out.

7. Remove the piston seal from the caliper cylinder bore. Check the piston and cylinder bore for wear and/or corrosion. Replace components as necessary.

To assemble:

8. Coat all components with clean brake fluid or lithium soap based glycol grease.
9. Install the piston seal and then the piston into the caliper cylinder bore. Seat the piston in the bore with your fingers.

10. Fit the boot into the groove in the cylinder bore and press in the set ring.

11. On FS17, install the main pin boots to the torque plate. Install the sub pin slide bushing into the torque plate.

12. On PD60, install the collar and dust boots into the caliper. Make sure they are firmly secured to the groove in the caliper. Install the bushing into the boots so that it is firmly set in the boot groove.

13. Install the caliper and brake pads.

14. Install the wheels and lower the truck. Bleed the brakes and road test the vehicle.

Brake Disc

REMOVAL AND INSTALLATION

1. Remove the brake pads and the caliper.
2. Check the disc run-out at this point. Make a note of the results for use during installation.
3. Remove the grease cap from the hub. Remove the cotter pin and the castellated nut.
4. Remove the wheel hub with the brake disc attached.
5. Perform the disc inspection procedure.

To install:

1. Coat the hub oil seal lip with multipurpose grease and install the disc/hub assembly.
2. Adjust the wheel bearing.
3. Measure the disc run-out. Check it against the specifications in the "Brake Specifications" chart and against the figures noted during removal.

NOTE: If the wheel bearing nut is improperly tightened, disc run-out will be affected.

4. Install the remainder of the components as outlined in the appropriate sections.
5. Bleed the brake system.
6. Road test the truck. Double check the wheel bearing preload.

INSPECTION

Examine the disc. If it is worn, warped or scored, it must be replaced. Check the thickness of the disc against the specifications given in the "Brake Specifications" chart. If below specifications, replace it. Use a micrometer to measure the thickness. Because the allowable wear from new thickness to minimum thickness is only 2mm (approx. 0.078 in), resurfacing the discs is not recommended.

The disc run-out should be measured before the disc is removed and again, after the disc is installed. Use a dial indicator mounted on a stand to determine run-out. If run-out exceeds the maximum specification, replace the disc.

- 2WD Truck, PD 60 brakes: 0.09mm (0.0035 in)
- 2WD Truck, PD 66 brakes: 0.12mm (0.0047 in)
- 2WD Truck, FS 17 or 18 Brakes: 0.09mm (0.0035 in)
- 4WD Truck and 4Runner: 0.09mm (0.0035 in)
- Land Cruiser: 0.015mm (0.0059 in)

NOTE: Be sure that the wheel bearing nut is properly tightened. If it is not, an inaccurate run-out reading may be obtained. If different run-out readings are obtained with the same disc, between removal and installation, this is probably the cause.

For Wheel Bearing removal, installation and adjustment please refer to Sections 1 or 7.

REAR DRUM BRAKES

CAUTION

Brake shoes contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from any brake surface. When cleaning brake surfaces, use a commercially available brake cleaning fluid.

Brake Drum

REMOVAL AND INSTALLATION

1. Remove the hub cap (if used) and loosen the lug nuts. Release the parking brake.
2. Block the front wheels, raise the rear of the truck, and support it with jackstands.

CAUTION

Support the truck securely.

3. Remove the wheels.
4. Unfasten the brake drum retaining screws, if used. Not all models have them.
5. Tap the drum lightly with a mallet in order to free it. If the drum cannot be removed easily, insert a screwdriver into the hole in the backing plate and hold the automatic adjusting lever away from the adjusting bolt. Using another screwdriver, relieve the brake shoe tension by turning the adjusting bolt clockwise. If the drum still will not come off, use a puller, but first make sure that the parking brake is fully released. On models with dual rear wheels, the drum is removed along with the rear axle shaft.

WARNING: Do not depress the brake pedal once the brake drum has been removed.

6. Inspect the brake drum.
7. To install the drum, simply replace the drum on the axle and tighten the retaining screw, if used. Adjust the brakes.
8. Install the wheels and lower the truck. Road test the vehicle checking for correct function.

INSPECTION

1. Clean the drum.
2. Inspect the drum for scoring, cracks, grooves and out-of-roundness. Replace the drum or have it "turned" at a machine or brake specialist shop, as required.
3. Light scoring may be removed by dressing the drum with fine emery cloth.
4. Heavy scoring will require the use of a brake drum lathe to turn the drum.

Brake Shoes

REMOVAL AND INSTALLATION

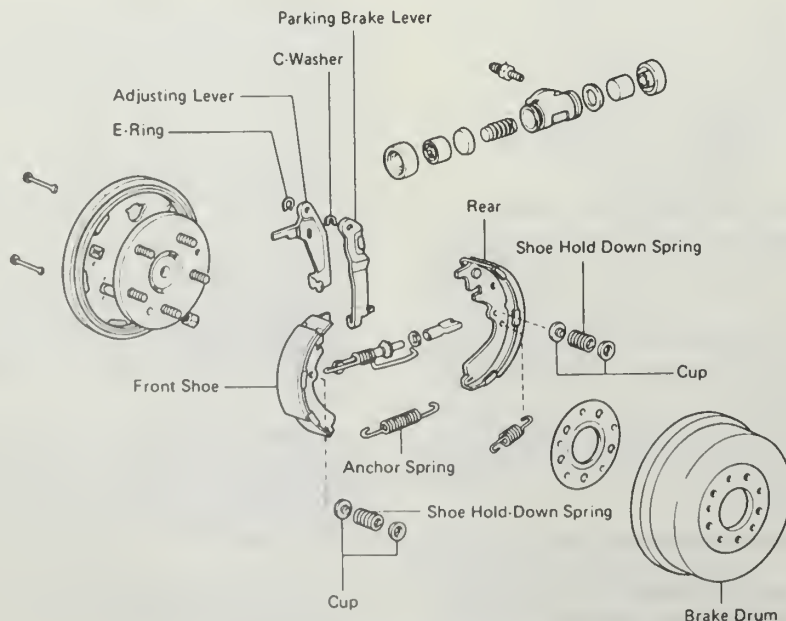
NOTE: Drum brakes require the use of two common brake tools to make the job easier. A brake spring "wrench" and a spring removing tool can be purchased at almost any automotive outlet for low cost. These are two of the handiest special tools you can own; they can generally be used on any vehicle with drum brakes.

2WD Truck With Leading-Trailing Brakes

1. Raise the rear of the truck and support it with safety stands. Remove the wheels.
2. Remove the brake drum.
3. Using a brake tool, remove the return spring adjuster.
4. Remove the front shoe hold-down spring and pin. Remove the front shoe with the anchor spring.
5. Remove the hold-down spring and pin and pull out the rear shoe.
6. Remove the E-clip and spread the C-washer to remove it from the parking brake lever. Remove the adjusting lever spring.
7. Remove the parking brake cable from the lever.

To install:

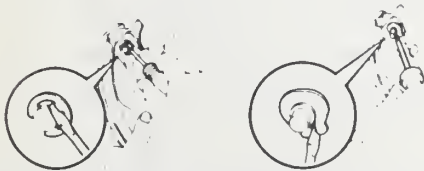
8. Apply high temperature grease to the brake backing plate and the threads and end of the adjuster bolt.



2WD leading-trailing brakes

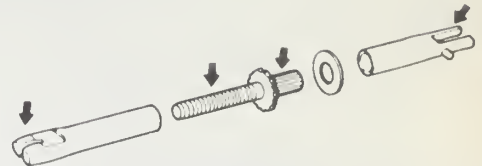
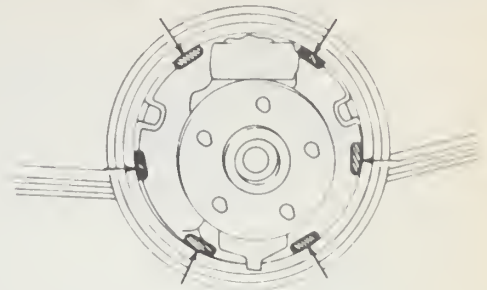


Removing the springs and adjusters



The E-clip can be pried off; the C-washer must be spread

9. Pull the parking brake cable out and connect it to the lever.
10. Connect the strut and return spring to the lever.
11. Position the rear shoe so that the upper end of the shoe is



Apply high-temperature grease to the areas indicated

in the wheel cylinder and the lower end is in the anchor plate. Install the pin and hold-down spring.

12. Connect the anchor spring to the rear shoe and then stretch it onto the front shoe.

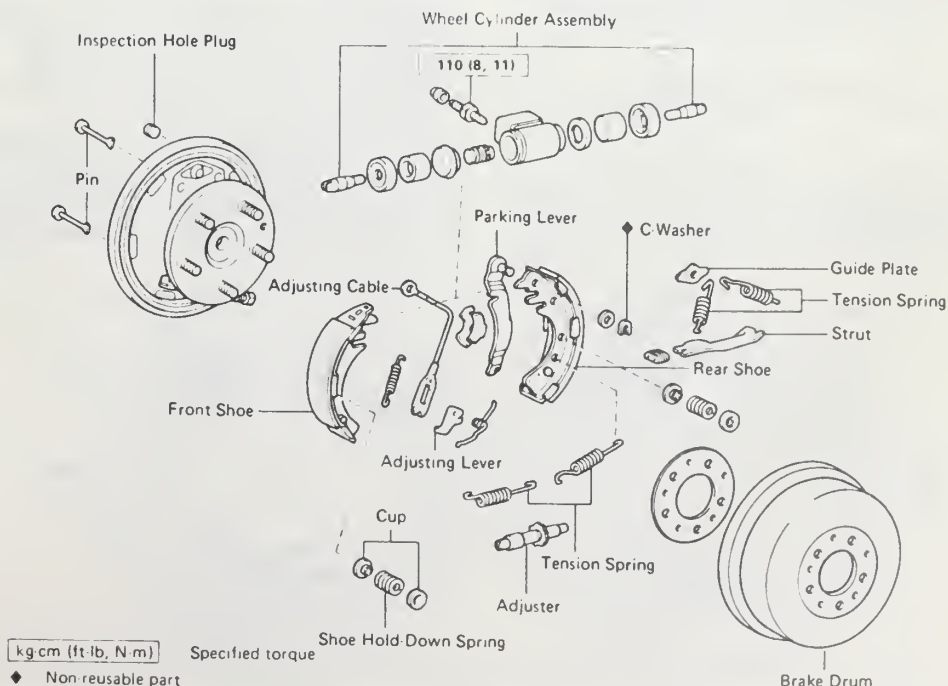
13. Position the front shoe so the upper end is in the wheel cylinder and the lower end is in the strut. Install the pin and hold-down spring.

14. Install the return spring.

15. Check that the adjuster bolt turns while pulling up on the brake lever. Adjust the strut to the shortest possible length and install the brake drum. Pull the parking brake lever (inside the truck) out until the clicks stop.

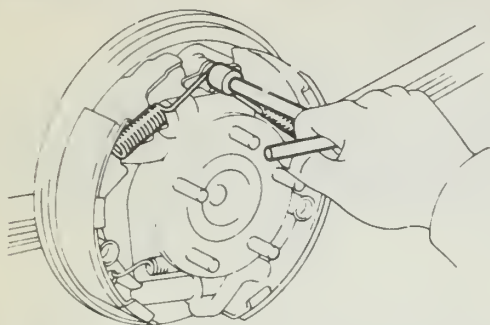
16. Remove the brake drum and check that the difference between the inner brake drum diameter and the outer brake shoe diameter is no more than 0.6mm.

17. Install the brake drum. Install the wheels and lower the truck. Bleed the brakes and road test the vehicle.

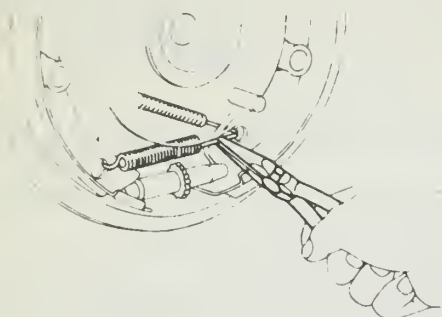


2WD duo-servo brakes

9 BRAKES



Use the correct tool to remove the shoe return springs



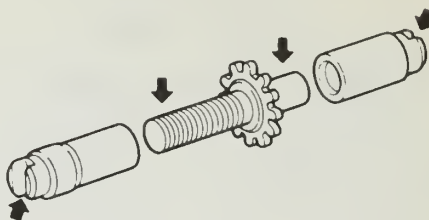
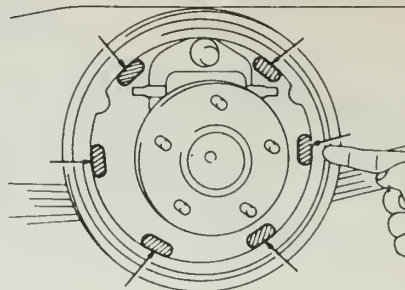
Remove the two tension springs

2WD Truck With Duo-Servo Brakes

1. Raise the rear of the truck and support it with safety stands. Remove the wheels.
2. Remove the brake drum.
3. Using a brake tool, remove the 2 return springs.
4. Push up on the brake adjusting lever and remove the cable, shoe guide plate and cable guide. Disconnect the spring at the brake lever and remove them both.
5. Using needle-nose pliers, remove the 2 tension springs.
6. Using a brake tool, remove the shoe hold-down springs and pins.
7. Remove the shoes, the adjuster and the strut.
8. Pull the parking brake cable out and disconnect it at the parking brake lever.

To install:

9. Apply high-temperature grease to the brake backing plate.
10. Pull the parking brake cable out and connect it to the lever.
11. Position the rear shoe so that its upper end is in the piston rod. Install the shoe hold-down spring and pin.

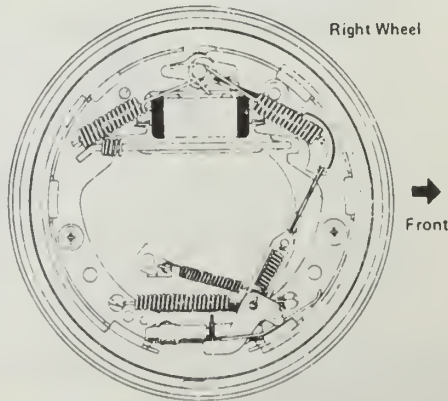
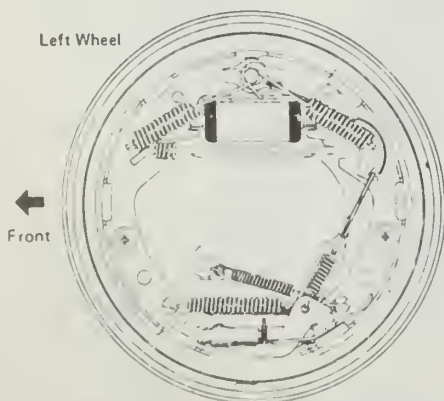


Apply high temperature grease to the areas shown

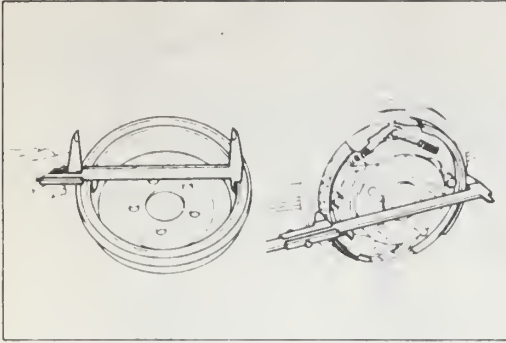


When installing the parking brake lever, the C-washer must be squeezed closed

12. Install the strut with the spring to the rear. Position the front shoe over the strut so that the upper end is in the piston rod. Install the hold-down spring and pin.
13. Grease the threads and end of the brake adjuster and install it between the brake shoes.
14. Install the shoe guide plate and the adjusting cable. Install the front return spring and then install the rear one.
15. While holding the tension spring against the rear shoe, hook the cable into the adjusting lever and install the lever. Pull the adjusting cable backward and release it; the adjusting bolt should turn.



It's easy to get the components in the wrong place at reassembly. Pay attention to correct placement



After preliminary adjustment, check the shoe diameter and drum diameter. Clearance should be 0.6mm (0.024 in.)

16. Adjust the strut to the shortest possible length and install the brake drum. Turn the drum in the reverse direction and have an assistant step on the brake pedal. Continue this process until the clicking noise is no longer heard.

17. Remove the brake drum and check that the difference between the inner brake drum diameter and the outer brake shoe diameter is no more than 0.6mm.

18. Install the brake drum. Install the wheels and lower the truck. Bleed the brakes and road test the vehicle.

4WD Truck, 4Runner and Land Cruiser

1. Raise the rear of the truck and support it with safety stands. Remove the wheels.

2. Remove the brake drum.

3. Remove the tension spring.

4. Remove the rear shoe hold-down spring and pin and then lift out the rear shoe and anchor spring.



Remove the front shoe with the adjuster; disconnect the parking brake cable

5. Remove the front shoe hold-down spring and pin. Disconnect the No. 1 parking brake cable at the bellcrank.

6. Remove the automatic adjusting lever and parking brake lever on Truck and 4Runner:

a. Remove the E-clip.

b. Remove the automatic adjusting lever.

c. Spread and remove the C-washer.

d. Remove the parking brake lever.

7. Remove the front shoe with the strut. Disconnect the other parking brake cable.

8. Disconnect the adjusting lever spring and remove the adjuster from the front shoe.

To install:

9. Assemble and install the parking brake bellcrank:

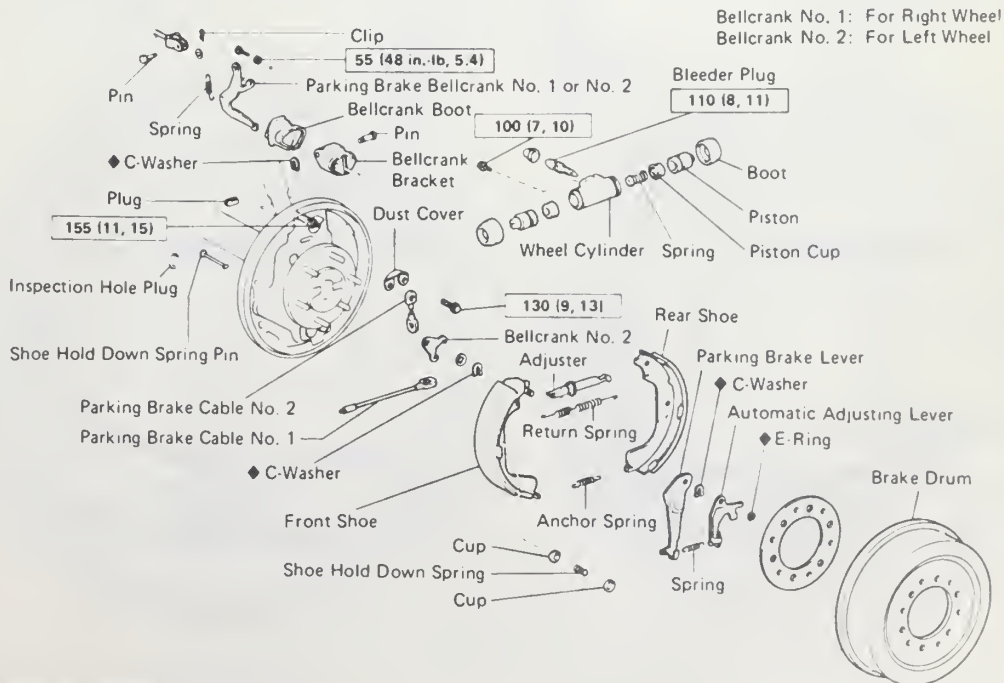
a. Apply grease to the rotating parts of the bellcrank.

b. Install the parking brake bellcrank to the bellcrank bracket.

c. Install the pin with a new C-clip and tighten it.

d. Install the bellcrank boot to the parking brake bracket.

e. Install the parking brake bellcrank and dust cover on the backing plate.



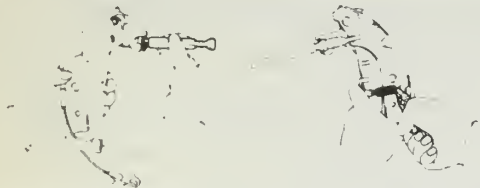
kg·cm (ft·lb, N·m) Specified torque

◆ Non reusable part

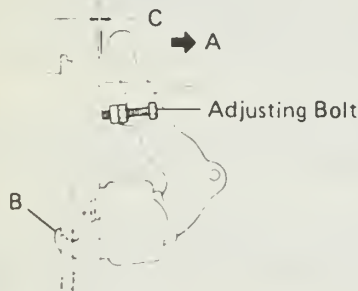
Rear brake components on 4WD vehicles. Truck shown, others similar

9 BRAKES

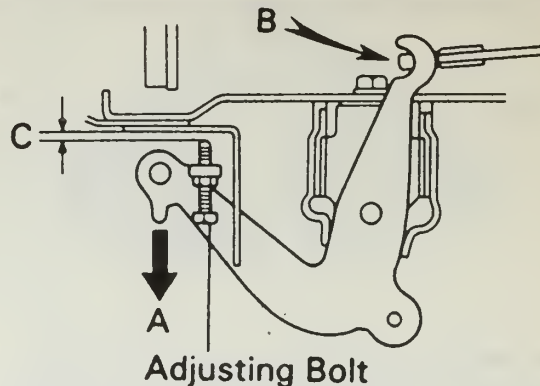
10. Apply high-temperature grease to the brake backing plate and the threads of the adjuster.
11. Position the parking brake lever and the automatic adjuster. Use new clips and tighten the C-clip.
12. Connect the parking brake cable to the shoe lever. Connect the other side of the cable to the bellcrank. Position the front shoe so the upper end is in the piston rod and install the hold-down spring and pin.
13. Connect the anchor spring to the front shoe and then stretch it onto the rear shoe. Position the rear shoe and install the hold-down spring and pin.



Install the adjuster to the front shoe and install the adjusting spring lever



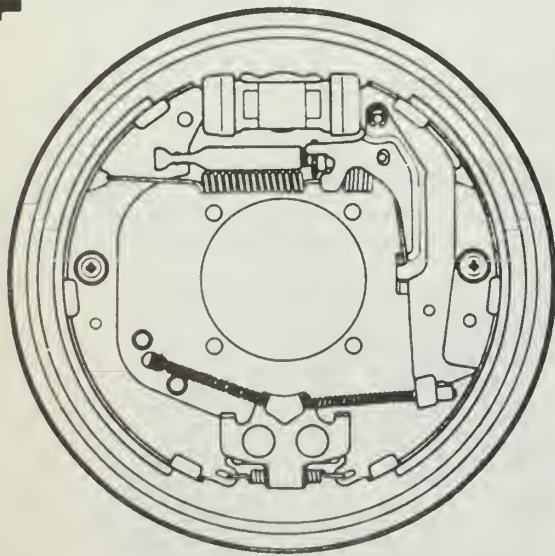
Bellcrank adjustment – Truck



Bellcrank adjustment – Land Cruiser

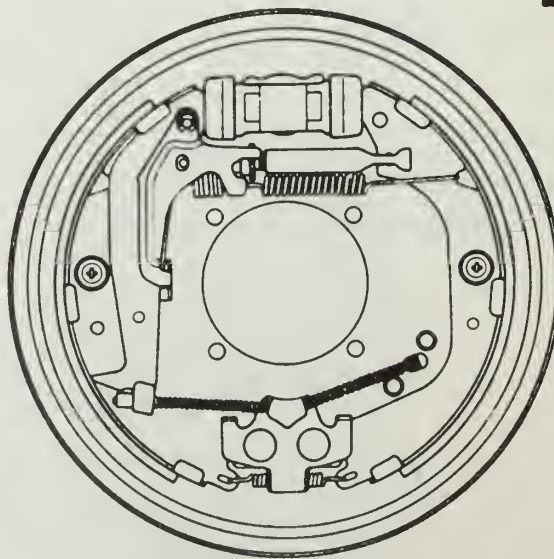
14. Install the tension spring. For Truck and 4Runner, the bellcrank in direction A until there is no slack at B. Turn the adjusting bolt so that C will be 0.4-0.8mm. Lock the adjusting bolt with the locknut.
15. Connect the parking brake cable to the bellcrank and install the tension spring.
16. Check that the parking brake lever (inside the truck) travel is correct and that the adjuster turns while pulling the lever.
17. Turn the adjuster to the shortest possible length and install the brake drum. Pull the parking brake lever (inside the truck) out until the clicks stop.
18. Remove the brake drum and check that the difference between the inner brake drum diameter and the outer brake shoe diameter is no more than 0.6mm.
19. Install the brake drum. Install the wheels and lower the truck. Bleed the brakes and road test the vehicle.

Front



Left Wheel

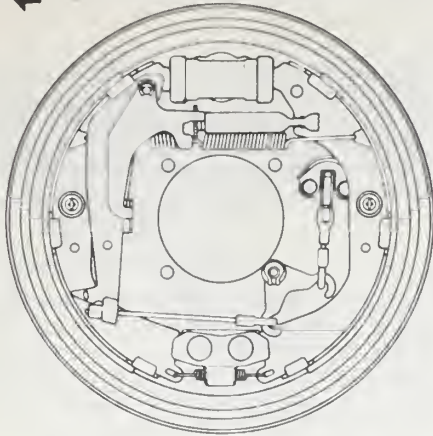
Front



Right Wheel

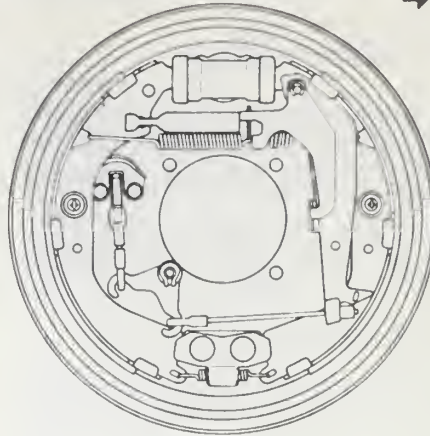
Correct Installation of 4Runner rear brakes

Front



Left Wheel

Front

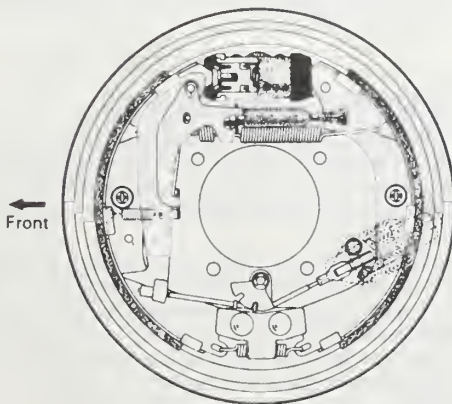


Right Wheel

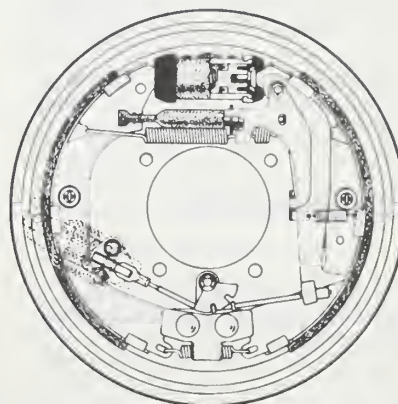
Correct Installation of Truck rear brakes

Left Wheel

Right Wheel



Front



Front

Correct Installation of Land Cruiser rear brakes

Wheel Cylinders

REMOVAL AND INSTALLATION

1. Plug the master cylinder inlet to prevent hydraulic fluid from leaking.
2. Remove the brake drums and shoes.
3. Working from behind the backing plate, disconnect the hy-

draulic line from the wheel cylinder. Plug the line to prevent fluid loss.

4. Unfasten the screws retaining the wheel cylinder and withdraw the cylinder.

To install:

5. Position the cylinder and install the bolts; tighten them to 7 ft. lbs. (10 Nm).
6. Connect the brake line, tightening it to 11 ft. lbs. (15 Nm).
7. Install the shoes and drums.
8. Bleed the brake system.

REAR WHEEL ANTI-LOCK BRAKES

General Description

The rear wheel anti-lock system found on Toyota trucks is designed to keep the rear wheels from locking under hard braking regardless of the load being carried. This function aids in keeping the vehicle from slewing sideways under hard braking with loss of directional stability.

Since the anti-lock system acts only on the rear wheels, it may be possible to lock the front wheels, causing them to skid; no steering response is possible if this happens.

SYSTEM OPERATION

The electro-hydraulic system employs one speed sensor in the differential housing. The speed signal is sent to the electronic control unit (ECU) which controls the operation of the control solenoid within the actuator. The solenoid controls brake line pressure within the single line running to the rear axle; the line branches to each wheel at the axle housing.

A significant difference in this system (from 4 wheel ABS) is that power steering fluid is circulated through the brake system actuator. The ABS control solenoid acts on the power steering fluid, not the brake fluid circuit. The power steering fluid acts as a control pressure circuit, moving pistons and valves within the actuator which control the brake fluid circuit. The power steering fluid and the brake fluid are kept completely separate within the systems; each fluid is kept within its normal system reservoir.

Use of the power steering fluid allows a supply of constantly pressurized fluid (from the power steering pump) and eliminates the need for larger, bulkier actuators with electric pumps and accumulators.

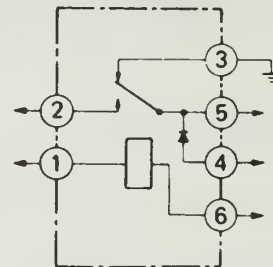
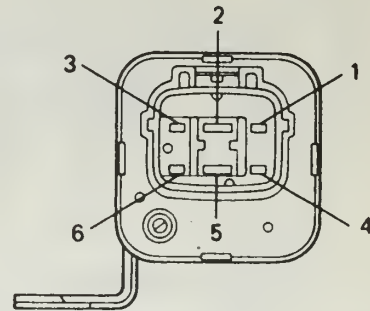
SYSTEM COMPONENTS

Speed Sensor

The speed sensor is located in the rear differential housing. It transmits a small electrical signal to the ECU based on the rotational speed of the differential ring gear.

Solenoid Relay

This relay, mounted on the inside of the right fender under the hood, controls the flow of electricity to the solenoid valve of the actuator.



Terminal Identification and schematic of the solenoid control relay. Note the diode between terminal 4 and terminal 5

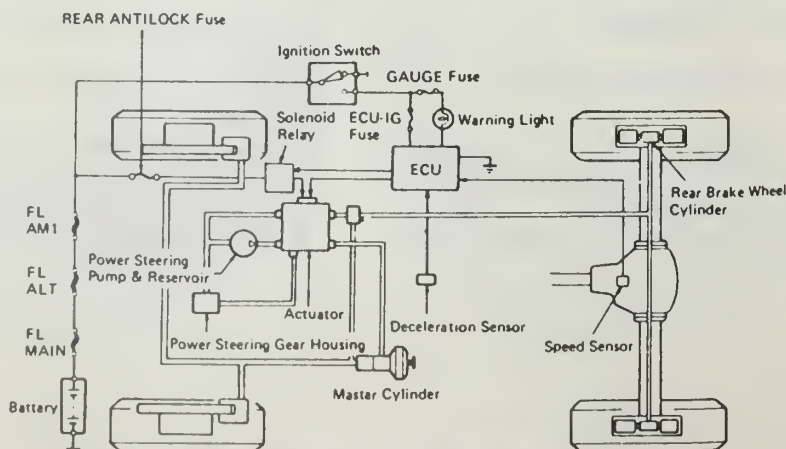
Electronic Control Unit (ECU)

The ECU is the electrical brain of the rear wheel anti-lock system. It interprets signals from the speed sensor and the deceleration sensor, determining if wheel lock-up is about to occur. The ECU output controls the solenoid relay which energizes the actuator solenoid.

Additionally, the ECU uses other input signals to determine system readiness and integrity. Should a fault be found, a fault code is assigned and stored in memory. The ECU will illuminate the REAR ANTILOCK warning lamp on the dashboard when a fault is noted. The ECU is located behind the glove box on the upper underside of the dash.

Deceleration Sensor

The deceleration sensor is located in the center of the vehicle



Rear wheel anti-lock schematic

behind the lower dash cover. It transmits signals to the ECU regarding deceleration rate.

Actuator

The hydraulic actuator contains the solenoid valve as well as the bypass and cut valves for the brake circuit. The solenoid controls the flow of power steering fluid into control circuits; the power steering fluid within these circuits act on pistons which move the bypass and cut valves, controlling the flow of brake fluid. The actuator is located at the lower right front of the engine compartment.

Power Steering Pump and Reservoir

Since power steering fluid is used to maintain internal pressure in the ABS actuator, the power steering system must be maintained in good order at all times. Loss of power steering line pressure will affect not only the steering but the anti-lock function as well. The reservoir must be kept at the correct level at all times; the correct power steering fluid is ATF DEXRON® II.

Dashboard Warning Lamp

The REAR ANTILOCK warning lamp will illuminate when the ECU detects a fault within the system. Additionally, it will illuminate briefly during start-up to serve as a bulb check and initial system check. If the dash warning lamp is lit, the anti-lock function to the rear wheels is disabled; the vehicle will retain normal braking capabilities.

Diagnosis and Testing

SYSTEM PRECAUTIONS

- Certain components within the system are not intended to be serviced or repaired individually. Only those components with removal and installation procedures should be serviced.
- Do not use rubber hoses or other parts not specifically specified for the anti-lock system. When using repair kits, replace all parts included in the kit.
- Use only DOT 3 brake fluid from an unopened container.
- If any hydraulic component (either power steering or brake) is removed or replaced, it may be necessary to bleed the entire system.
- A clean repair area is essential. Always clean the reservoir and cap thoroughly before removing the cap. The slightest amount of dirt in the fluid may plug an orifice and impair the system function. Perform repairs after components have been thoroughly cleaned; use only denatured alcohol to clean components. Do not allow components to come into contact with any substance containing mineral oil; this includes used shop rags.
- The ECU is a microprocessor similar to other computer units in the vehicle. Insure that the ignition switch is **OFF** before removing or installing controller harnesses. Avoid static electricity discharge at or near the controller.
- If any arc welding is to be done on the vehicle, the ECU should be disconnected before welding operations begin.
- If the vehicle is to be baked after paint repairs, disconnect and remove the ECU from the vehicle.

DIAGNOSTIC CODES

If a malfunction occurs, the system will identify the problem and the computer will assign and store a fault code for the fault(s). The dashboard warning lamp will be illuminated to inform the driver that a fault has been found.

During diagnostics, the system will transmit the stored code(s) by flashing the dashboard warning lamp. If two or more codes are stored, they will be displayed from lowest number to

highest, regardless of the order of occurrence. The system does not display the diagnostic codes while the vehicle is running.

INITIAL CHECKS

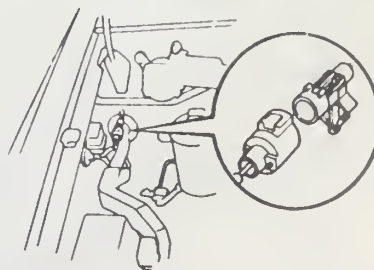
Visual Inspection

Before diagnosing an apparent rear anti-lock problem, make absolutely certain that the normal braking system and power steering systems are in correct working order. Many common problems (dragging parking brake, seepage, etc.) will affect the ABS system. A visual check of specific system components may reveal problems creating an apparent ABS malfunction. Performing this inspection may reveal a simple failure, thus eliminating extended diagnostic time.

1. Inspect the brake fluid level in the reservoir.
2. Inspect lines, hoses, master cylinder assembly, brake calipers and cylinders for leakage. Inspect the power steering system and components for the same conditions.
3. Visually check lines and hoses for excessive wear, heat damage, punctures, contact with other parts, missing clips or holders, blockage or crimping.
4. Check the calipers or wheel cylinders for rust or corrosion. Check for proper sliding action if applicable.
5. Check the caliper and wheel cylinder pistons for freedom of motion during application and release.
6. Inspect the speed sensor for proper mounting and correct connection.
7. Confirm the fault occurrence. Certain driver induced faults, such as not releasing the parking brake fully, will set a fault code and trigger the dash warning light. Excessive wheel spin on low-traction surfaces, high speed acceleration or riding the brake pedal may also set fault codes and trigger a warning lamp. These induced faults are not system failures but examples of vehicle performance outside the parameters of the control unit.
8. Many system shut-downs are due to loss of sensor signals to or from the controller. The most common cause is not a failed sensor but a loose, corroded or dirty connector. Check harness and component connectors carefully.

Diagnostic System Checks

1. Turn the ignition switch **OFF**. Check battery condition; approximately 12 volts is required to operate the system.
2. Turn the ignition switch **ON** and check that the REAR ANTILOCK dashboard warning lamp comes on for 2 seconds. If the lamp does not come on, repair the fuse, bulb or wiring.
3. Read the stored diagnostic code(s), if any, as follows:
 - a. With the ignition **ON**, disconnect the service connector on the right fender apron near the firewall.



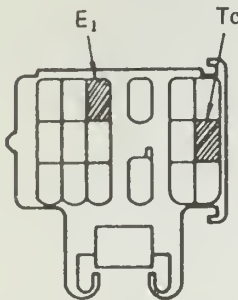
Rear wheel anti-lock service connector

- b. Use a jumper wire to connect terminals Tc and E1 of the check connector. This is not the service connector.
- c. If a fault code has been set, the dashboard warning lamp will begin to blink 4 seconds later. The number of flashes corresponds to the first digit of a 2-digit code; after a 1.5 second

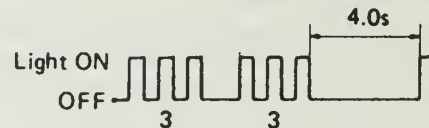
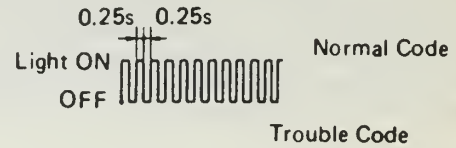
9 BRAKES

Code No.	Light Pattern	Diagnosis	Multifunctioning Part
	ON OFF 	Speed sensor and sensor rotor are normal	
77		Abnormal output signal of speed sensor	Sensor rotor (Differential ring gear)
88		ECU mismatched	ECU

Speed sensor diagnostic codes



ABS diagnostic terminals at the check connector



Displaying diagnostic codes

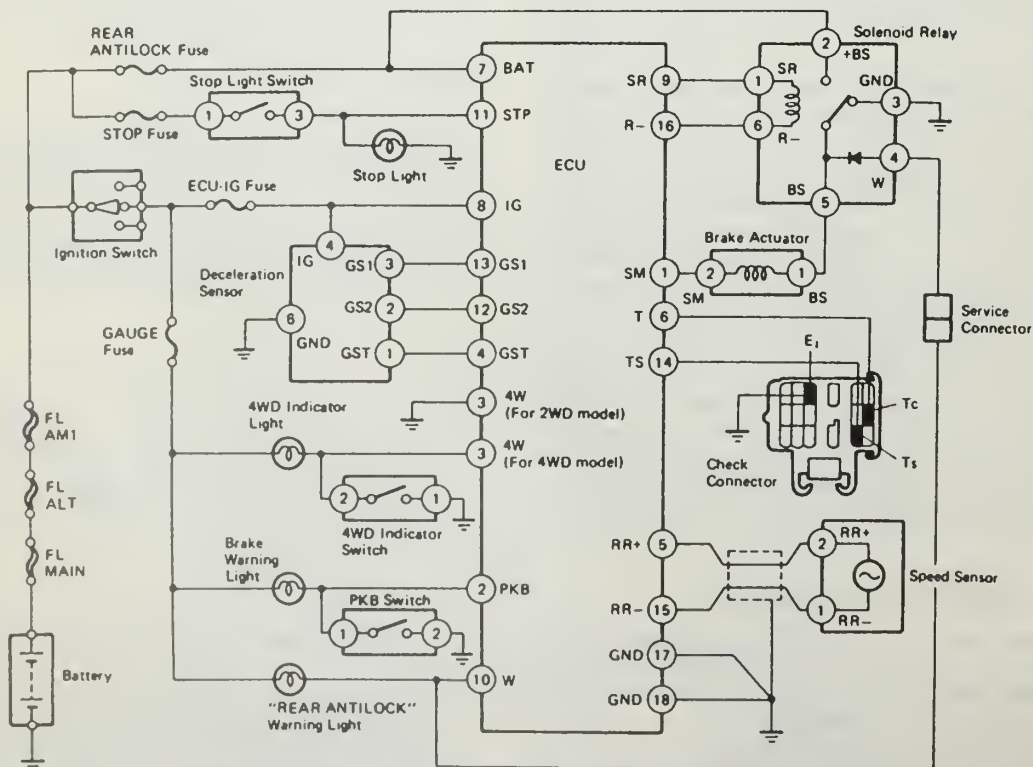
pause, the second digit is transmitted. If a second code is stored, it will be displayed after a 2.5 second pause. Once all codes have been displayed, the entire series will repeat after a 4 second pause.

d. If no codes have been stored, the warning lamp will flash continuously every 1/2 second with no variation.

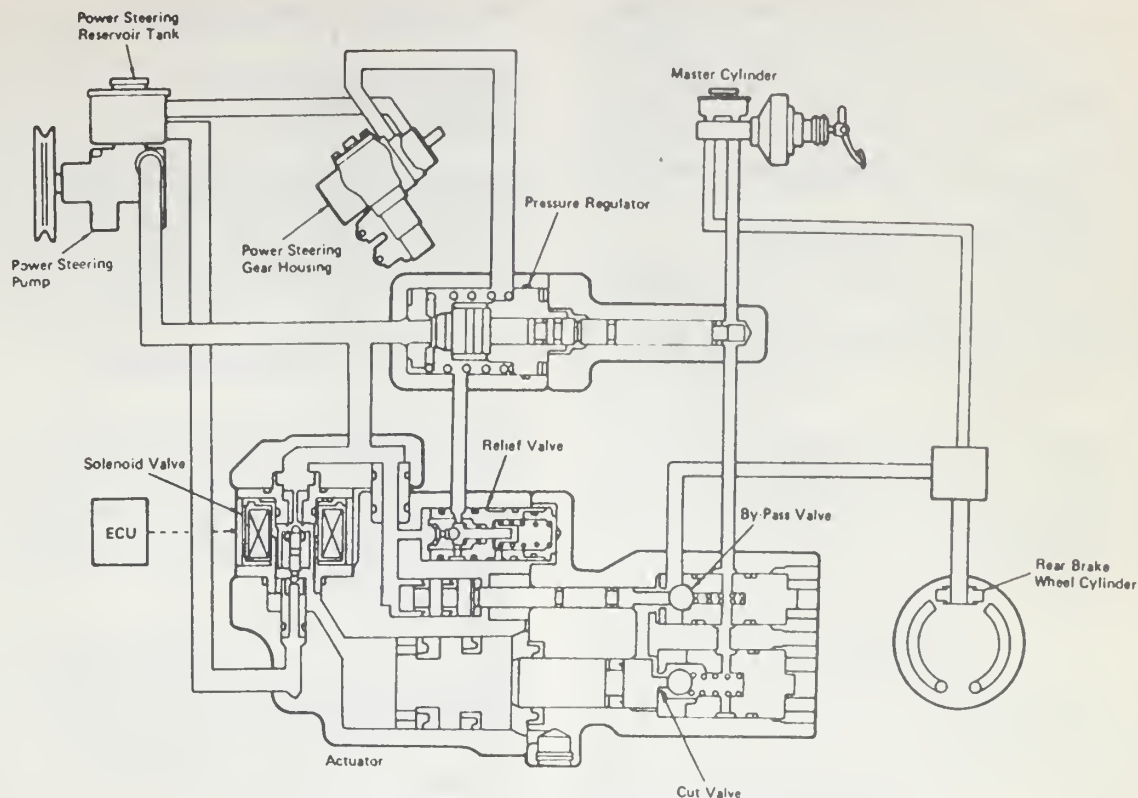
4. Turn the ignition OFF.

5. Check or repair the system as indicated by the fault code.6. After repairs are completed, clear the codes from the memory. If the battery is disconnected during repairs, the controller memory will be erased of all stored codes.

7. Remove the jumper wire if one was used and reconnect the service connector at the actuator.



Wiring schematic — Rear wheel anti-lock brakes



Hydraulic schematic – Rear wheel anti-lock brakes

TROUBLESHOOTING – REAR WHEEL ANTI-LOCK

Code No	Light Pattern	Diagnosis
11	ON OFF	Open circuit in solenoid relay circuit or solenoid circuit
12		Short circuit in solenoid relay circuit
25		Short circuit in solenoid circuit
33		Open or short circuit in speed sensor circuit
41		Low battery voltage (9.5 V or lower)
42		Abnormally high battery voltage (17 V or higher)
43		Mechanical malfunction in deceleration sensor
44		Electrical malfunction in deceleration sensor circuit
Always ON		Malfunction in ECU

Rear anti-lock fault codes

Problem	No
"REAR ANTILOCK" warning light	
Always comes on after ignition switch is turned to ON	1
Does not come on for about 2 seconds after ignition switch on	2
Comes on and off.	3
Comes on while running	1
Brakes pull	4
Braking inefficient.	4
Rear Wheel Anti-Lock Brake System operates at ordinary braking	4
Rear Wheel Anti-Lock Brake System operates just before stopping at ordinary braking	4
Brake pedal pulsates abnormally while Rear Wheel Anti-Lock Brake System is operating	4
Slidding noise occurs while Rear Wheel Anti-Lock Brake System working (Rear Wheel Anti-Lock Brake System works inefficiently)	5

1 "REAR ANTILOCK" warning light comes on.

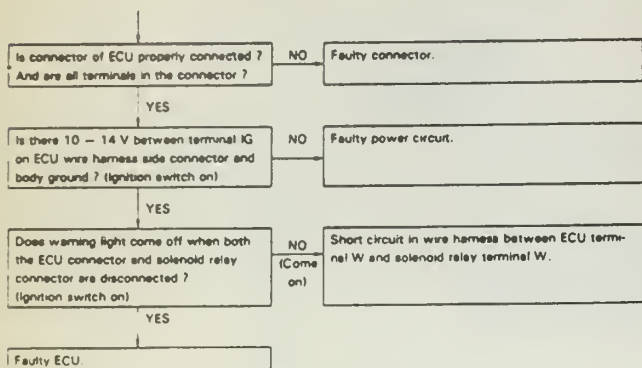
Disconnect service connector and connect the terminal Tc to E₁ of the check connector.

Does warning light always come on or show the normal code? (Ignition switch on)

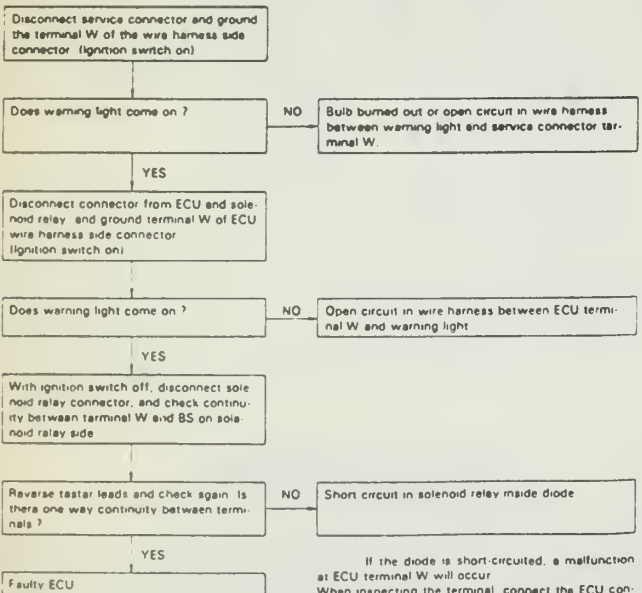
NO See diagnostic code

YES

TROUBLESHOOTING — REAR WHEEL ANTI-LOCK



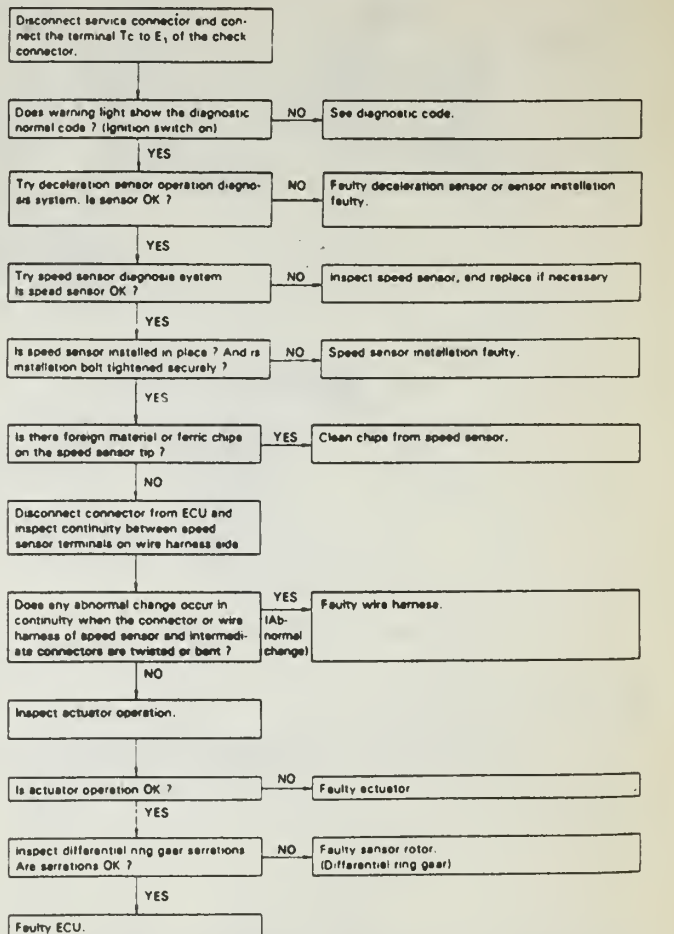
2 "REAR ANTILOCK" warning light does not come on for about 2 seconds after ignition switch on.



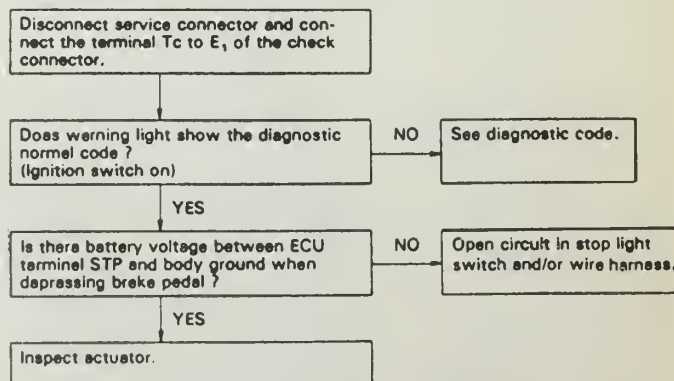
3 "REAR ANTILOCK" warning light comes on and off.

Short circuit in wire harness between ECU terminal TS and check connector terminal Ts.
Short circuit in wire harness between ECU terminal T and check connector terminal Tc.

4 Braking inefficient.
Rear-Wheel Anti-Lock Brake System operates at ordinary braking.
Rear-Wheel Anti-Lock Brake System operates just before stopping at ordinary braking.
Brake pedal pulsates abnormally while Rear-Wheel Anti-Lock Brake System working.



5 Rear-Wheel Anti-Lock Brake System works inefficiently.



CLEARING DIAGNOSTIC CODES

Turn the ignition switch **ON** and disconnect the service connector. Use the jumper wire to connect terminals Tc and E1 of the check connector. Depress the brake pedal 8 or more times within 3 seconds.

After the rapid pedal application, the dash warning lamp should display constant flashing, indicating a normal system. If codes are still displayed, make certain the repairs made to the system are correct. Also inspect the brake light switch at the brake pedal for any binding or sticking.

Once the codes are cleared, disconnect the jumper wire. The dash warning lamp should go out.

SPEED SENSOR

Diagnosis

The ECU is equipped to electronically check the function of the speed sensor and assign additional fault codes as needed.

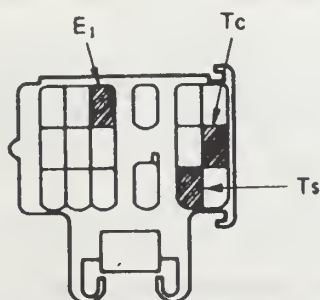
NOTE: The following procedures require driving the vehicle while it is in the diagnostic mode. The anti-lock system will be disabled; only normal braking function will be available.

1. If working on a 4WD vehicle, make certain it is only in 2WD. Check the battery voltage with the engine off; voltage should be approximately 12 volts.

2. With the ignition switch **ON**, make certain the REAR ANTILOCK warning lamp comes on for about 2 seconds and then goes out. Turn the ignition switch **OFF**.

3. Using a 3-way jumper, connect terminals Tc, Ts and E1 at the check connector.

4. Pull the parking brake on securely and start the motor without stepping on the brake pedal. Depressing the brake pedal will either void the test or cause the system to enter a different diagnostic mode.



All 3 terminals must be connected for speed sensor or deceleration sensor diagnosis

5. The dashboard warning lamp should flash evenly about 4 times per second. If, instead, a code is flashed, repairs must be made and the code(s) cleared before continuing. If the light does not flash, check the parking brake switch, the check connector and the wiring to the ABS controller.

6. To check the sensor signal level, release the parking brake and drive the vehicle straight ahead at low speed. Once a speed of 2.5–3.7 mph is reached, the warning lamp should turn off. Once the light has gone off, it should begin to blink as the vehicle leaves the speed range. This blinking is normal and indicates the speed sensor is operating correctly. If no blinking occurs, the system is defective.

7. Check the sensor signal change by driving the vehicle on the road. Once a speed of 25–31 mph is achieved, the warning lamp should come on after a one second pause. As before, the lamp should blink evenly as the vehicle leaves the speed range; failure to blink indicates a system fault.

NOTE: While the warning lamp is off, do not subject the vehicle to any shocks or impact such as shifting, acceleration, deceleration or road impact.

8. Stop the vehicle in a safe location and apply the parking brake fully. Read and record any stored codes which are displayed.

9. Turn the ignition switch **OFF**; remove the jumper wire from the check connector.

DECELERATION SENSOR

Testing

NOTE: The following procedures require driving the vehicle while it is in the diagnostic mode. The anti-lock system will be disabled; only normal braking function will be available.

1. Check the battery voltage with the engine off; voltage should be approximately 12 volts.

2. With the ignition switch **ON**, make certain the REAR ANTILOCK warning lamp comes on for about 2 seconds and then goes out. Turn the ignition switch **OFF**.

3. Use a jumper wire to connect terminals Tc, Ts and E1 at the check connector.

4. Apply the parking brake fully, depress the brake pedal and start the engine.

5. After a short delay, the dashboard warning lamp should flash about once every second. This is slower than the usual system flashing when transmitting a code.

6. Release the parking brake and drive the vehicle straight ahead at 12.4 mph or greater speed. Strongly depress the brake pedal; the warning lamp should begin flashing evenly and rapidly, about 8 times per second.

7. If the warning lamp display does not meet specifications, check the installation of the deceleration sensor. It must be correctly and securely installed. If installation is proper, replace the sensor and retest the system.

8. Stop the vehicle and turn the ignition switch **OFF**. Remove the jumper wire from the check connector.

Solenoid Control Relay

Testing

1. With the ignition switch **OFF**, remove the control relay from its bracket. The relay has 6 terminals.

2. Use an ohmmeter to test continuity. There should be continuity between terminals 1 and 6.

3. Place the lead of the ohmmeter on terminal 3; check for continuity at terminal 5 but not at terminal 4. Place the lead on terminal 4; continuity should be found at terminals 3 and 5.

4. Apply battery voltage to terminal 1 and ground terminal 6. Place the lead of the ohmmeter on terminal 2; check for continuity at terminal 5 but not at terminal 4. Place the lead on terminal 4; continuity should be found at terminals 2 and 5.

5. All test conditions must be met. If any test is failed, the relay must be replaced.

SPEED SENSOR

Testing

1. Check the installation of the sensor. If the mounting bolt is loose, tighten it to 14 ft. lbs. (19 Nm).

2. Disconnect the speed sensor connector from the ABS harness

3. Measure the resistance between the terminals of the sensor connector. Correct resistance is 580–700 ohms. If the resistance is outside the specification, the sensor must be replaced.

4. Check that there is no continuity between each sensor ter-

9 BRAKES

minimal and the sensor body. If any continuity is found, the sensor is faulty.

5. Reconnect the speed sensor to the harness.

Component Replacement

FILLING THE SYSTEM

The brake fluid reservoir is located on top of the master cylinder. While no special procedures are needed to fill the fluid, the reservoir cap and surrounding area must be wiped clean of all dirt and debris before removing the cap. The slightest dirt in the fluid can cause a system malfunction. Use only DOT 3 fluid from an unopened container. Use of old, polluted or non-approved fluid can seriously impair the function of the system.

The power steering reservoir is located near the pump. Use only the correct fluid—ATF DEXRON® II—from an unopened container. Always wipe the reservoir cap and surrounding area free of dirt before opening the reservoir. Dirt in the power steering fluid can affect the brake actuator.

BLEEDING THE SYSTEM

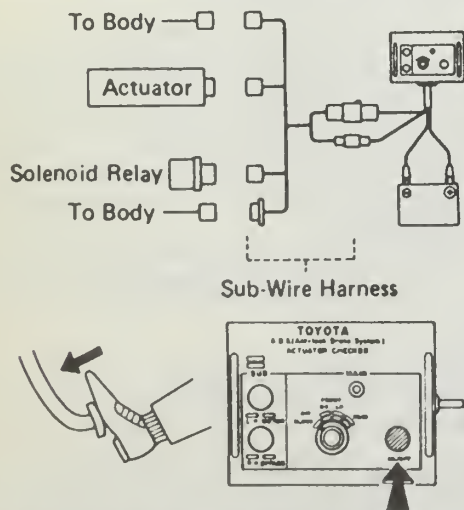
Brake system bleeding is performed in the usual manner, using either a pressure bleeder or the 2-person manual method. If a pressure bleeder is used, it must be of the diaphragm type with an internal diaphragm separating the air chamber from the fluid. Tighten each bleeder plug to 8 ft. lbs. (11 Nm).

Always begin the bleeding with the longest brake line, then the next longest, and so on. If the master cylinder has been repaired or if the reservoir has been emptied, the master cylinder will need to be bled before the individual lines and calipers. During any bleeding procedure, make certain to maintain the fluid level above the MIN line on the reservoir. When the bleeding procedure is complete, fill the reservoir to the MAX line before reinstalling the cap.

POWER STEERING SYSTEM BLEEDING

Whenever the actuator, power steering hose or component is changed or loosened the rear wheel anti-lock brake system should be bled using the following procedure. Normal bleeding of each system may not remove all the air from the actuator.

NOTE: This procedure requires the use of the Toyota ABS Actuator Checker and adapter harness (Tools 09990-00150 and 09990-00205) or their equivalent.



correct hook-up for Toyota ABS checker

1. Bleed the power steering system using regular procedure. The bleeder valve is located on the steering gearbox.

2. Bleed the brake system with the engine running. Bleed the brake system again with the engine off.

3. Disconnect the wiring connector at the actuator and at the solenoid relay.

4. Connect the ABS checker and harness to the actuator, relay and body wiring harness, using the adapters as necessary.

5. Connect the red cable of the checker to the positive battery terminal and the black cable to the negative battery terminal.

6. Start the engine and run it at idle.

7. Turn the selector switch on the ABS checker to the AIR BLEED position. Strongly depress the brake pedal and hold it in that position.

8. Push the ON/OFF switch (on the checker) for about 3 seconds and release it; do this 5 times.

NOTE: Do not push the ON/OFF switch before the brake pedal is depressed — master cylinder damage may occur. Do not release the brake pedal while the switch is engaged. Do not hold the ON/OFF switch ON more than 5–7 seconds.

9. After 5 repetitions, release the switch and then release the brake pedal.

10. Check the level of the power steering and brake fluids in their reservoirs; top off each as necessary using the correct fluid.

11. Disconnect and remove the ABS checker. Reconnect the system connectors.

Brake Actuator

REMOVAL AND INSTALLATION

1. Disconnect both battery cables. Remove the battery and tray.

2. Disconnect the electrical connector at the actuator.

3. Disconnect the two brake lines from the actuator. Plug the lines to prevent fluid loss and the entry of dirt.

4. Turn the steering wheel clockwise until it locks. Remove the union (banjo) bolts holding the power steering pressure hoses to the actuator. It may be easier to work through the wheel house instead of from the top.

5. Disconnect the power steering hose(s).

6. Remove the bolt holding the power steering hose clamp or retainer.

7. Remove the 3 bolts holding the actuator bracket to the body. Remove the actuator and bracket together.

8. Remove the bracket from the actuator on the workbench.

To install:

9. Reinstall the bracket to the actuator; tighten the 3 bolts to 9 ft. lbs. (13 Nm).

10. Install the actuator to the vehicle; install the front retaining bolt first, then the middle one and then the rear most one. Tighten each to 21 ft. lbs. (28 Nm) when it is installed.

11. Using new gaskets, connect the pressure unions. Tighten each bolt to 34 ft. lbs. (47 Nm).

12. Connect the power steering hose(s) and secure the hose clamp(s).

13. Install the retaining clamp and tighten the bolt.

14. Connect the 2 brake lines to the actuator. Connect the painted line to the painted actuator port first. Tighten the lines to 11 ft. lbs. (15 Nm).

15. Connect the electrical connector at the actuator.

16. Install the battery and tray; connect the cables.

17. Fill the brake fluid and power steering reservoirs with the correct fluid.

18. Bleed the brake system; bleed the power steering system.

Speed Sensor

REMOVAL AND INSTALLATION

1. Disconnect the sensor cable connector from the harness. If the sensor cable is held by brackets or clamps, release them.
2. Remove the retaining bolt holding the sensor to the differential.
3. Remove the sensor straight out of its mount. Protect the tip from impact or abrasion.

To install:

4. Install the sensor, making certain it is firmly seated and not crooked in its mount.
5. Tighten the retaining bolt to 14 ft. lbs. (19 Nm).
6. Reinstall any mounting clips or brackets for the sensor cable and connect the cable to the ABS harness.
7. Double check the cable routing; it must be completely clear of any moving components.

Deceleration Sensor

REMOVAL AND INSTALLATION

1. Remove the lower center cover from the instrument panel.
2. Remove the 2 bolts holding the deceleration sensor bracket and lift the unit free.
3. With the ignition **OFF**, disconnect the wiring connector at the sensor. Remove the sensor and bracket assembly.

To install:

4. Connect the wire harness connector to the sensor. Install the sensor and bracket; tighten the retaining bolts to 48 inch lbs. (5.4 Nm).

NOTE: The sensor must be mounted approximately level in the vehicle. The mounting bolts must be equally snug to keep the unit from rocking or being on an angle.

5. Install the lower center cover on the instrument panel.

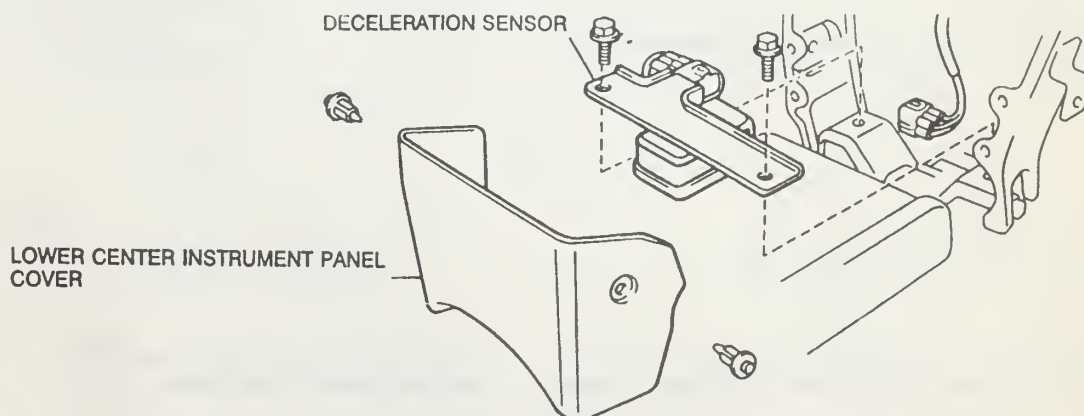
Electronic Control Unit (ECU)

REMOVAL AND INSTALLATION

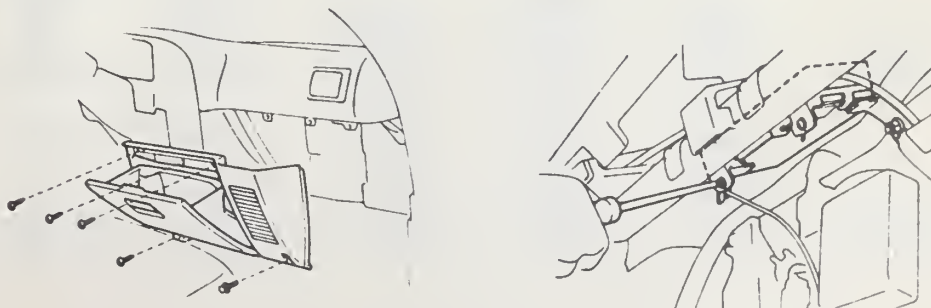
1. Remove the 4 screws and 1 bolt holding the glove box in place and remove the glove box assembly.
2. Remove the 2 screws and 1 nut holding the ECU in place. Gently pull the ECU down for access.
3. Make certain the ignition switch is **OFF**. Disconnect the wiring connector from the ECU and remove the unit.

To install:

4. With the ignition **OFF**, connect the ECU to the wire harness.
5. Install the unit, tightening the nuts and bolts snugly.
6. Reinstall the glove box.



The deceleration sensor is located behind the lower center instrument panel



Replacing the ECU

PARKING BRAKE

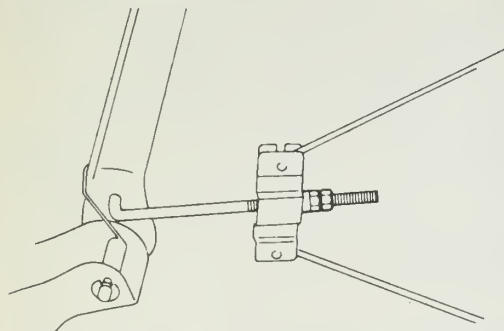
ADJUSTMENT

Truck and 4Runner

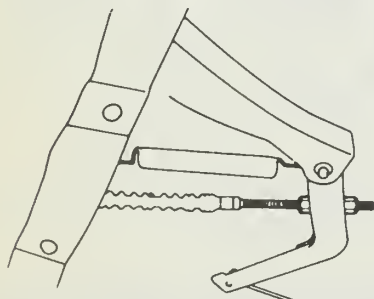
1. Pull the parking brake lever all the way out (or up) and count the number of clicks to the end of travel. 2WD ½-ton trucks should have 12-18 clicks; 1-ton, 2WD trucks and all 4WD trucks should have 11-17 clicks. On 4Runner, check for 13-19 clicks; on Land Cruiser, it's 7-9 clicks. If the parking brake lever is not within these ranges, adjust it.

2. Under the truck on 2WD models, there is an equalizer bar where the 2 cables come together. Tighten or loosen the adjusting nut until the lever travel is within the proper range. Check that the rear brakes are not dragging.

3. Working under the truck on 4WD models, tighten the bellcrank stopper screw until the play in the rear brake links be-



Parking brake adjuster, 2WD Trucks



Parking brake adjuster, 4WD Trucks. 4Runner similar

comes zero, and then loosen the screw 1 turn. Tighten the locknut.

Tighten one of the adjusting nuts on the intermediate lever while loosening the other one until the lever travel is correct. Tighten the adjusting nuts.

After adjustment, check that the bellcrank stopper screw is touching the back of the brake backing plate.

4. Recheck the parking brake travel.

Land Cruiser

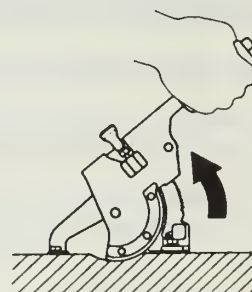
1. Before adjusting the parking brake, make certain the rear brakes are correctly adjusted.

2. Remove the parking brake lever cover.

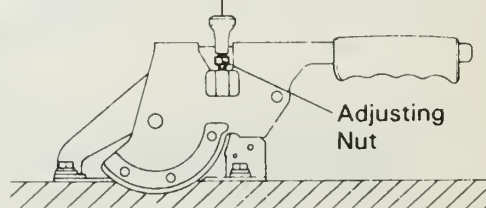
3. Loosen the adjusting cap; turn the adjusting screw until the lever travel is correct.

4. Tighten the adjusting cap.

5. Install the parking brake cover.



Adjusting Cap



Adjusting Nut

Check the lever travel, then adjust the Land Cruiser parking brake at the lever.

BRAKE SPECIFICATIONS

(All specifications in inches)

Years	Model	Original Thickness	Brake Disc		Orig. Inside Dia.	Brake Drum	
			Minimum Thickness	Maximum Run-out		Max. Wear Limit	Maximum Machine O/S
1989-91	Truck	0.984 ①	0.906 ①	0.0035 ①	10.00 ⑤	10.079 ⑤	—
		1.181 ②	1.102 ②	0.047 ②			
		0.866 ③	0.787 ③	0.0035 ③	11.614 ⑥	11.693 ⑥	—
		0.787 ④	0.709 ④	0.035 ④			
1989-91	4-Runner	0.787	0.709	0.035	11.61	11.69	—
1989-91	Land Cruiser	0.787	0.748	0.0059	11.614	11.693	—

① PD 60 Type

② PD 66 Type

③ FS 17 & 18 Type

④ S12 & 12 Type

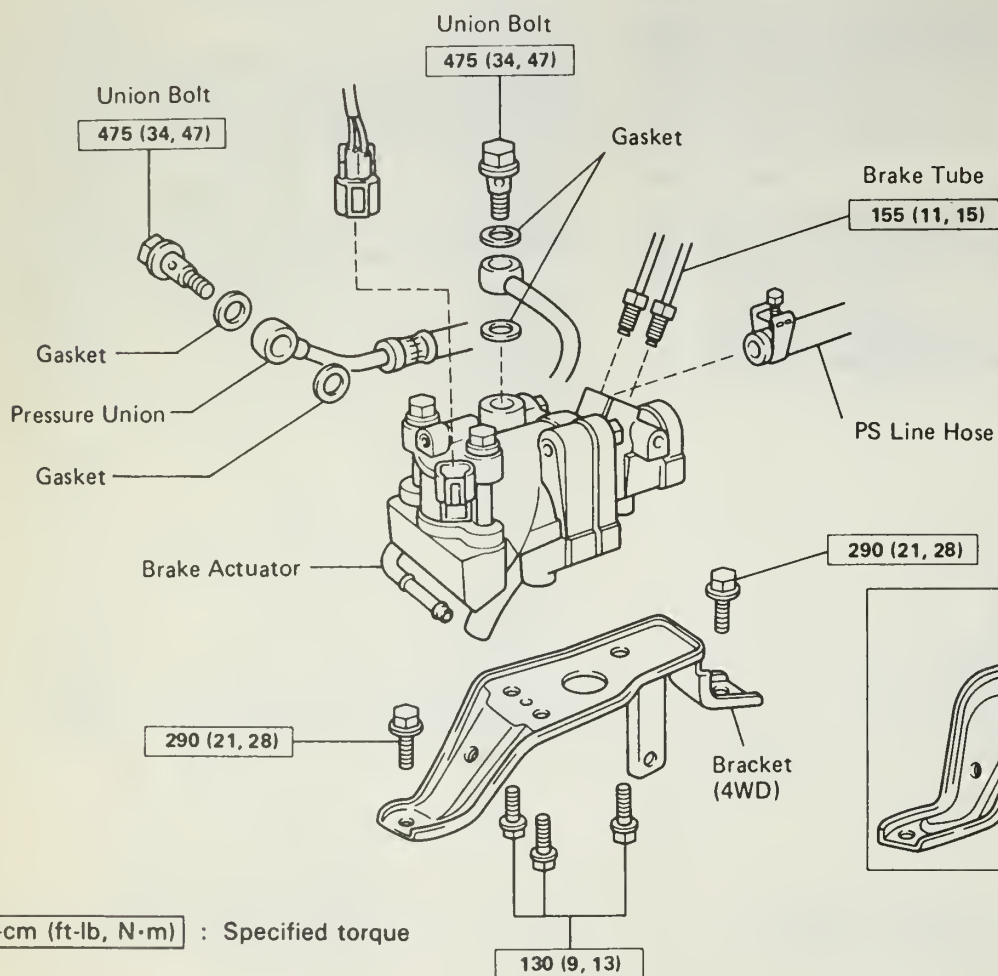
⑤ 2WD

⑥ 4WD

TORQUE SPECIFICATIONS

Component	English	Metric
ABS actuator-to-bracket:	9 ft. lbs.	13 Nm
ABS actuator bracket retaining bolts:	21 ft. lbs.	28 Nm
ABS actuator pressure unions:	34 ft. lbs.	47 Nm
Brake bleeder plugs:	8 ft. lbs.	11 Nm
Brake lines-to-actuator:	11 ft. lbs.	15 Nm
Brake line-to-caliper		
Exc. 1991 Land Cruiser:	11 ft. lbs.	15 Nm
1991 Land Cruisers:	22 ft. lbs.	30 Nm
Brake line-to-wheel cylinder:	11 ft. lbs.	15 Nm
Caliper mounting bolts		
4WD Vehicles:	90 ft. lbs.	123 Nm
2WD Trucks with FS 17 or 18 brakes:	65 ft. lbs.	88 Nm
2WD Trucks with PD 60 or 66 brakes:	29 ft. lbs.	39 Nm
Deceleration Sensor:	48 inch lbs.	5 Nm
Master cylinder		
Cylinder-to-booster:	9 ft. lbs.	13 Nm
3-way union fittings:	11 ft. lbs.	15 Nm
Piston stopper bolt:	7 ft. lbs.	10 Nm
Outlet plugs		
Land Cruiser:	33 ft. lbs.	44 Nm
Reservoir retaining bolt		
Trucks and 4Runner:	15 inch lbs.	2 Nm
Land Cruiser:	18 ft. lbs.	25 Nm
Power booster mounting bolts:	9 ft. lbs.	13 Nm
Speed sensor mounting bolt:	14 ft. lbs.	19 Nm
Wheel cylinder mounting bolts:	7 ft. lbs.	10 Nm

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Brake actuator installation

10

Body

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How to Remove Stains from Fabric Interior

For best results, spots and stains should be removed as soon as possible. Never use gasoline, lacquer thinner, acetone, nail polish remover or bleach. Use a 3' x 3" piece of cheesecloth. Squeeze most of the liquid from the fabric and wipe the stained fabric from the outside of the stain toward the center with a lifting motion. Turn the cheesecloth as soon as one side becomes soiled. When using water to remove a stain, be sure to wash the entire section after the spot has been removed to avoid water stains. Encrusted spots can be broken up with a dull knife and vacuumed before removing the stain.

Type of Stain	How to Remove It
Surface spots	Brush the spots out with a small hand brush or use a commercial preparation such as K2R to lift the stain.
Mildew	Clean around the mildew with warm suds. Rinse in cold water and soak the mildew area in a solution of 1 part table salt and 2 parts water. Wash with upholstery cleaner.
Water stains	Water stains in fabric materials can be removed with a solution made from 1 cup of table salt dissolved in 1 quart of water. Vigorously scrub the solution into the stain and rinse with clear water. Water stains in nylon or other synthetic fabrics should be removed with a commercial type spot remover.
Chewing gum, tar, crayons, shoe polish (greasy stains)	Do not use a cleaner that will soften gum or tar. Harden the deposit with an ice cube and scrape away as much as possible with a dull knife. Moisten the remainder with cleaning fluid and scrub clean.
Ice cream, candy	Most candy has a sugar base and can be removed with a cloth wrung out in warm water. Oily candy, after cleaning with warm water, should be cleaned with upholstery cleaner. Rinse with warm water and clean the remainder with cleaning fluid.
Wine, alcohol, egg, milk, soft drink (non-greasy stains)	Do not use soap. Scrub the stain with a cloth wrung out in warm water. Remove the remainder with cleaning fluid.
Grease, oil, lipstick, butter and related stains	Use a spot remover to avoid leaving a ring. Work from the outside of the stain to the center and dry with a clean cloth when the spot is gone.
Headliners (cloth)	Mix a solution of warm water and foam upholstery cleaner to give thick suds. Use only foam—liquid may streak or spot. Clean the entire headliner in one operation using a circular motion with a natural sponge.
Headliner (vinyl)	Use a vinyl cleaner with a sponge and wipe clean with a dry cloth.
Seats and door panels	Mix 1 pint upholstery cleaner in 1 gallon of water. Do not soak the fabric around the buttons.
Leather or vinyl fabric	Use a multi-purpose cleaner full strength and a stiff brush. Let stand 2 minutes and scrub thoroughly. Wipe with a clean, soft rag.
Nylon or synthetic fabrics	For normal stains, use the same procedures you would for washing cloth upholstery. If the fabric is extremely dirty, use a multi-purpose cleaner full strength with a stiff scrub brush. Scrub thoroughly in all directions and wipe with a cotton towel or soft rag.

EXTERIOR

Doors

REMOVAL AND INSTALLATION

1. Matchmark the hinge-to-body and hinge-to-door locations. Support the door either on jackstands or have somebody hold it for you.

2. On models with a center door check bar, push in on the claw and pull out the stopper pin. Alternatively, unbolt the door check from the door.

NOTE: Depending on equipment, it may be necessary to disconnect various wires running into the door.

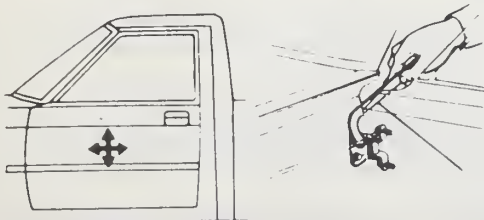
3. Remove the lower hinge-to-door bolts.
4. Remove the upper hinge-to-door bolts and lift the door off the hinges.
5. If the hinges are being replaced, remove them from the door pillar.
6. Install the door and hinges with the bolts finger tight.
7. Adjust the door and tighten the hinge bolts.

ADJUSTMENT/ALIGNMENT

When checking door alignment, look carefully at each seam between the door and body. The gap should be constant and even all the way around the door. Pay particular attention to the door seams at the corners farthest from the hinges; this is the area where errors will be most evident. Additionally, the door should pull against the weatherstrip when latched to seal out wind and water. The contact should be even all the way around and the stripping should be about half compressed.

The position of the door can be adjusted in three dimensions: fore and aft, up and down, in and out. The primary adjusting points are the hinge-to-body bolts. Apply tape to the fender and door edges to protect the paint. Two layers of common masking tape works well. Loosen the bolts (using special tool MB 098120-00010 if necessary) just enough to allow the hinge to move. With the help of an assistant, position the door and retighten the bolts. Inspect the door seams carefully and repeat the adjustment until correctly aligned.

The in-out adjustment (how far the door "sticks out" from the body) is adjusted by loosening the hinge-to-door bolts. Again, move the door into place, then retighten the bolts. This dimension affects both the amount of crush on the weatherstrips and the amount of "bite" on the striker.

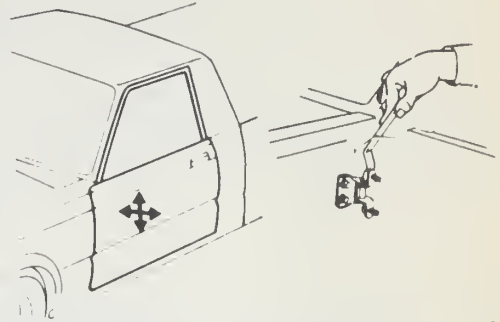


Adjusting the fore/aft and vertical dimensions

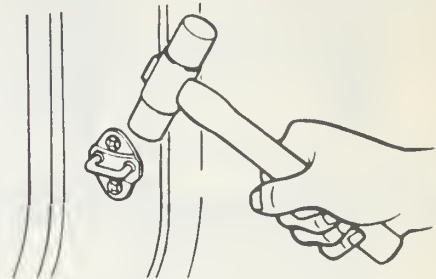
Further adjustment for closed position and smoothness of latching is made at the latch plate or striker. This piece is located at the rear edge of the door and is attached to the bodywork; it is the piece the latch engages when the door is closed.

Although the striker size and style may vary between models or from front to rear, the method of adjusting it is the same:

1. Loosen the large cross-point screw(s) holding the striker. Know in advance that these bolts will be very tight; an impact screwdriver is a handy tool to have for this job. Make sure you are using the proper size bit.



Adjust the lateral and vertical dimensions at the hinge to door bolts



Another method of adjusting the striker

2. With the bolts just loose enough to allow the striker to move if necessary, hold the outer door handle in the released position and close the door. The striker will move into the correct location to match the door latch. Open the door and tighten the mounting bolts. The striker may be adjusted towards or away from the center of the car, thereby tightening or loosening the door fit.

The striker can be moved up and down to compensate for door position, but if the door is correctly mounted at the hinges this should not be necessary.

NOTE: Do not attempt to correct height variations (sag) by adjusting the striker.

3. Additionally, some models may use one or more spacers or shims behind the striker. These shims may be removed or added in combination to adjust the reach of the striker.

4. After the striker bolts have been tightened, open and close the door several times. Observe the motion of the door as it engages the striker; it should continue its straight-in motion and not deflect up or down as it hits the striker.

5. Check the feel of the latch during opening and closing. It must be smooth and linear, without any trace of grinding or binding during engagement and release.

It may be necessary to repeat the striker adjustment several times (and possibly re-adjust the hinges) before the correct door to body match is produced.

Hood

REMOVAL AND INSTALLATION

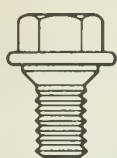
NOTE: You'll need an assistant for this job.

1. Open the hood.
2. Remove the hood support bolts.
3. Matchmark the hood-to-hinge position.
4. Remove the hood-to-hinge bolts and lift off the hood.
5. Installation is the reverse of removal. Loosely install the hood and align the matchmarks. Tighten all bolts.

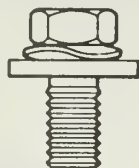
ADJUSTMENT

NOTE: A tapered, self-centering bolt is used as the hood hinge set bolt. The hood cannot be adjusted with this bolt in place. Remove it and substitute a bolt and washer which will allow adjustment.

1. Loosen the hood to hinge bolts slightly. Adjust the hood fore-and-aft or left-and-right. Tighten the bolts.
2. Adjust the front edge of the hood up-and-down by turning the two cushions higher or lower. The hood should align with the fender edges.
3. On Truck and 4Runner, remove the wiper arms, then remove the cowl cover below the windshield. Inside the cowl plenum, adjust the hinge-to-body bolts to control the height of the rear of the hood. Reinstall the cowl panel and wipers.
4. On Land Cruiser, the rear hood height is adjusted by loosening the four mounting screws holding the hinge to the firewall.

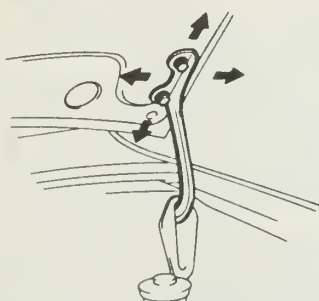


Centering Bolt



Bolt with Washer

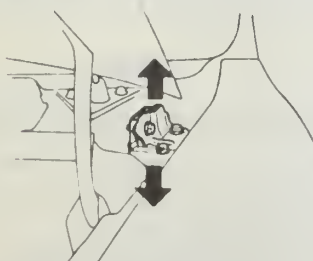
Remove the centering bolt and substitute a flat bolt until the adjustment is complete



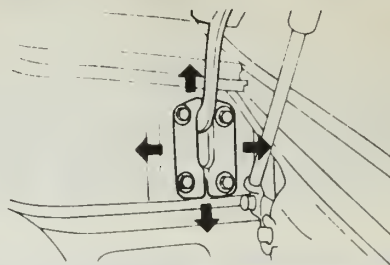
This is the most common hood adjustment



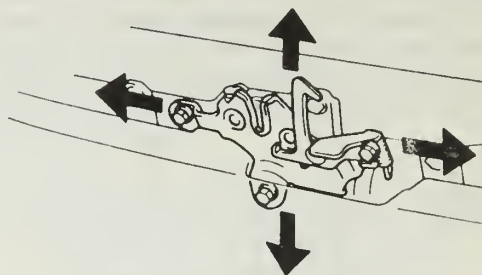
Turn the cushions to adjust front hood height



Adjust the Truck and 4Runner rear hood height after removing the cowl



Land Cruiser rear hood height adjustment



Adjust the hood latch

5. Loosen the hood latch retaining bolts and adjust the latch by moving it up/down or left/right.
6. Close the hood and check the tension needed to release the hood. If the release requires excessive force, the latch is under tension and must be adjusted.

Tailgate

REMOVAL AND INSTALLATION

1. Remove the tailgate support stay at the T-head pivot.
2. Remove the 2 bolts at the tailgate hinge.
3. Remove the tailgate and torsion bar.
4. Installation is the reverse of removal.

Rear Door

REMOVAL AND INSTALLATION

4Runner

1. Lower the door glass into the door all the way.
2. Remove the four bolts and clamps holding the torsion bar to the door. Remove the clip.
3. Remove the torsion bar from the door; remove the two bolts and remove the torsion bar guide.
4. Remove the two bolts and remove the door stay.
5. Support the door; remove the four door hinge bolts and remove the door.
6. Reinstall in reverse order. Tighten the hinge bolts to 22 ft. lbs. (29 Nm).

Land Cruiser

UPPER DOOR

NOTE: An assistant is required for this procedure.

1. Remove the inner door panel trim. Disconnect any wiring connectors for harnesses running between the door and body.
2. Remove the bolts holding the door supports to the door.
3. Support the door in a convenient position allowing access to the hinge bolts.
4. Remove the hinge bolts and remove the door. The door is

reasonably heavy and not balanced. Use caution when removing or carrying the door.

5. Reinstall in reverse order, tightening the hinge bolts to 22 ft. lbs. (29 Nm.).

LOWER DOOR

1. Remove the inner trim panel.
2. Disconnect the wiring to the license plate light and other electrical equipment.
3. Disconnect the stays.
4. Remove the hinge bolts and remove the door.
5. Reinstall in reverse order, tightening the hinge bolts to 25 ft. lbs. (34 Nm).

Front or Rear Bumper

REMOVAL AND INSTALLATION

1. Support the bumper.
2. Remove any trim pieces, corner moldings, etc. on the bumper. Remove the nuts and bolts attaching the bumper to the frame.
3. Installation is the reverse of removal.

Outside Mirrors

REMOVAL AND INSTALLATION

The mirrors can be removed from the door without disassembling the door liner or other components. Both left and right outside mirrors may be either manual, manual remote (small lever on the inside to adjust the mirror) or, in some cases, electric remote. If the mirror glass is damaged, replacements may be available through your dealer or a reputable glass shop. If the plastic housing is cracked or damaged, the entire mirror unit must be replaced. To remove the mirror:

1. If the mirror is manual remote, check to see if the adjusting handle is retained by a hidden screw, usually under an end cap on the lever. If so, remove the screw and remove the adjusting knob.
2. Remove the delta cover. That's the triangular inner cover where the mirror mounts to the door. It can be removed with a blunt plastic or wooden tool. Don't use a screwdriver; the plastic will be marred.
3. Depending on the model and style of mirror, there may be concealment plugs or other minor parts under the delta cover. Remove them. If electric connectors are present, disconnect them.
4. Support the mirror housing from the outside and remove the three bolts or nuts holding the mirror to the door. Remove the mirror.
5. When installing, fit the mirror to the door and install the nuts and bolts to hold it. Connect any wiring. Pay particular attention to the placement and alignment of any gaskets or weatherstrips around the mirror; serious wind noises may result from careless work.
6. Install the delta cover, pressing it firmly into position. Install the control lever knob if it was removed.

Antenna

REMOVAL AND INSTALLATION

Manual Antenna

1. Disconnect the antenna cable at the radio by pulling it straight out of the set. Depending on access, this may require loosening the radio and pulling it out of the dash.
2. Working under the instrument panel, disengage the cable from its retainers.

NOTE: On some models, it may be necessary to remove the instrument panel pad to get at the cable.

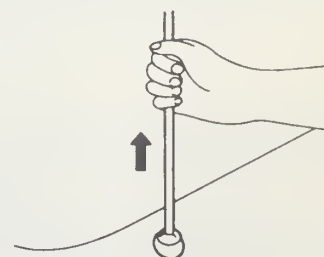
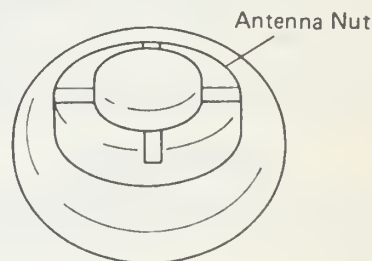
3. Outside, unsnap the cap from the antenna base.
4. Remove the screw(s) and lift off the antenna, pulling the cable with it, carefully.
5. When reinstalling, make certain the antenna mount area is clean and free of rust and dirt. The antenna must make a proper ground contact through its base to work properly.
6. Install the screws and route the cable into the cab. Make certain the cable is retained in the clips, etc.
7. Connect the cable to the radio; reinstall the radio if it was removed.

Power Antenna Mast

NOTE: The power antenna system contains a relay. If the power antenna is inoperative, the relay is the first place to look. The actual motor rarely fails.

The power antenna mast is replaceable on Trucks and 4Runners. If the mast is damaged or broken, proceed as follows:

1. Perform this repair with the battery cables connected. Turn the ignition switch to the LOCK position.
2. Remove the antenna nut.
3. If equipped with a CD player, press the AM and FM buttons on the receiver and simultaneously turn the ignition switch to ACC.
4. For non-CD player units, press the AM button and simultaneously turn the ignition switch to ACC.

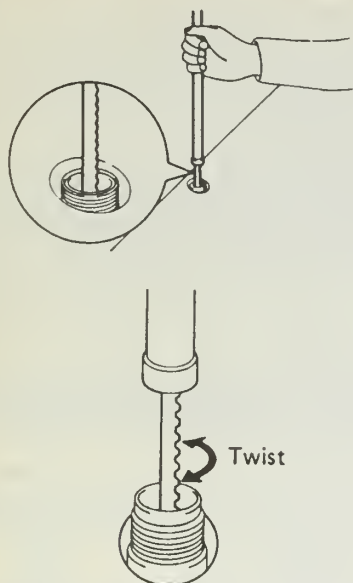


Remove the antenna nut, then use the motor to extend the mast

5. The antenna motor will run, unwinding the mast from the spool. Have an assistant guide the mast so it doesn't fall and damage the bodywork. When fully extended, the mast will be released. Remove it, and leave the ignition in the ACC position.

To install:

6. Insert the new cable so that the teeth face the rear of the vehicle. Feed the cable into the motor until the cable reaches the bottom, about 12 in. (305mm).
7. Have an assistant ready and prepared to guide the cable. Turn the ignition switch to LOCK. The motor will run, winding the cable onto the spool and drawing the antenna down into the mount.



Install the new mast with the teeth facing the rear of the vehicle; a slight twist may be needed if it won't wind onto the spool

8. If the cable does not wind, twist the cable at the top of the housing; the part at the bottom may have turned while being pushed down the hole.

9. Once wound onto the spool, install the antenna nut even if the antenna is not fully retracted. Test the antenna elevation and retraction; the mast will eventually retract fully.

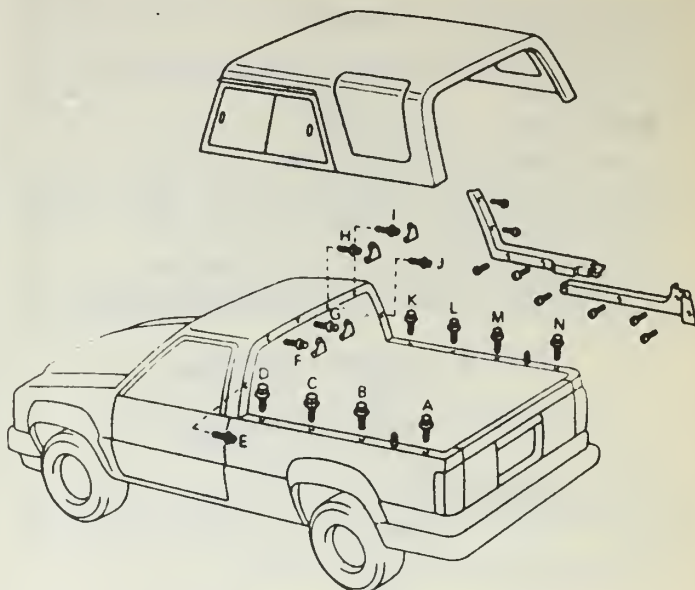
Cover Top

REMOVAL AND INSTALLATION

4Runner Only

NOTE: Not all 4Runners have removable tops.

1. Open the rear window and remove the body garnishes.
2. Disconnect the electrical lead and the hose at the rear washer motor.



Removable roof for some 4Runners

3. Remove mounting bolt B and then remove the other bolts.
4. Remove the cover top and place it on pieces of wood on the ground.

WARNING: Mounting bolt "B" controls the cover top switch. When removed, the rear power window cannot be operated. Never install it when the cover top is removed.

5. Position the cover top on the truck body and install bolts E and J. Install bolts C and L. Tighten all bolts to 10 ft. lbs. (14 Nm).

6. Loosen bolts E and J.

7. Install and tighten bolts D and K and then retighten bolts E and J.

8. Install all remaining bolts and tighten them to 10 ft. lbs. (14 Nm). Install and tighten bolt B.

9. Connect the washer motor lead and hose, install the garnishes and close the tailgate. Check for proper operation of the rear window.

INTERIOR

Door Panels (Door pads or liners)

REMOVAL AND INSTALLATION

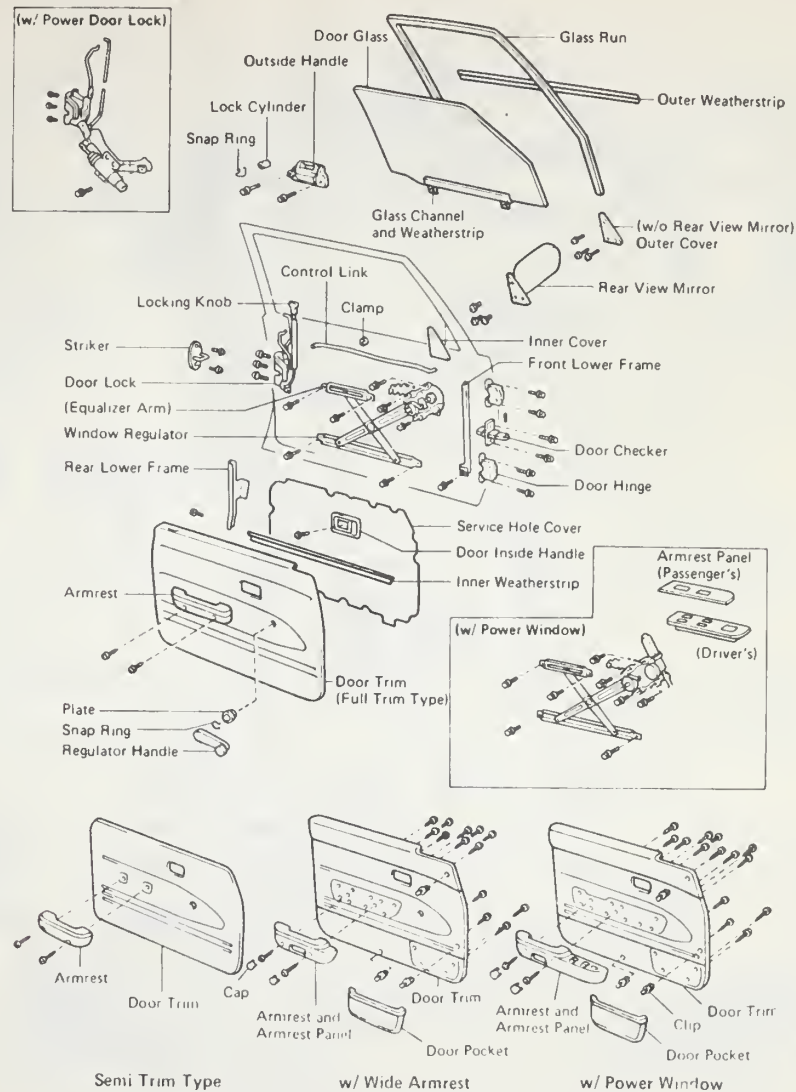
NOTE: This is a general procedure. Depending on vehicle and model, the order of steps may need to be changed slightly.

1. Remove the inner mirror control knob (if manual remote) and remove the inner delta cover from the mirror mount.

2. Remove the screws holding the armrest and remove the armrest. The armrest screws may be concealed behind plastic caps which may be popped out with a non-marring tool.

3. Remove the surround or cover for the inside door handle.

w/o Ventilator Window Type



Front door components — Truck

Again, seek the hidden screw; remove it and slide the cover off over the handle.

4. If not equipped with electric windows, remove the window winder handle. This can be tricky, but not difficult. Install a piece of tape on the door pad to show the position of the handle before removal. The handle is held onto the winder axle by a spring clip shaped like the Greek letter omega: “Ω”. The clip is located between the back of the winder handle and the door pad. It is correctly installed with the legs pointing along the length of the winder handle. There are three common ways of removing the clip:

a. Use a door handle removal tool. This inexpensive slotted and toothed tool can be fitted between the winder and the panel and used to push the spring clip free.

b. Use a rag or piece of cloth and work it back and forth between the winder and door panel. If constant upward tension is kept, the clip will be forced free. Keep watch on the clip as it pops out; it may get lost.

c. Straighten a common paper clip and bend a very small J-hook at the end of it. Work the hook down from the top of the winder and engage the loop of the spring clip. As you pull the

clip free, keep your other hand over the area. If this is not done, the clip will vanish to an undisclosed location, never to be seen again.

5. In general, power door lock and window switches mounted on the door pad (not the armrest) may remain in place until the pad is removed. Some cannot be removed until the doorpad is off the door.

6. If the car has manual vertical door locks, remove the lock knob by unscrewing it. If this is impossible (because they're in square housings) wait until the pad is lifted free.

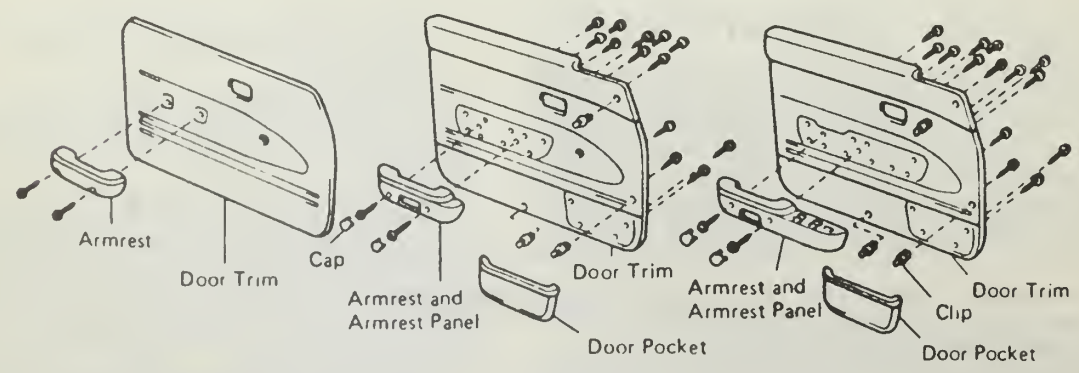
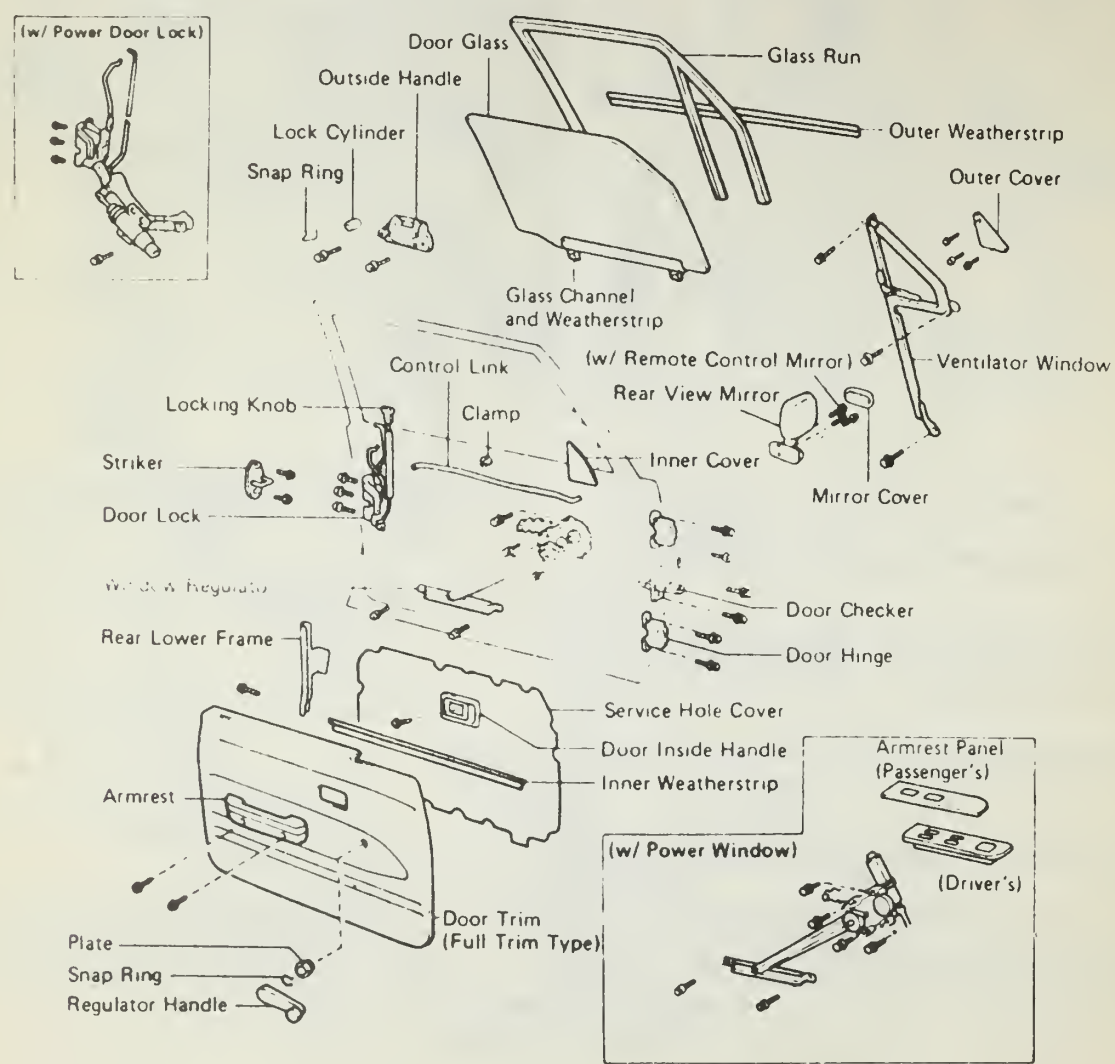
7. Using a broad, flat-bladed tool — not a screwdriver — begin gently prying the door pad away from the door. You are releasing plastic inserts from plastic seats. There will be 6 to 12 of them around the door. With care, the plastic inserts can be reused several times.

8. When all the clips are loose, lift up on the panel to release the lip at the top of the door. This may require a bit of jiggling to loosen the panel; do so gently and don't damage the panel. The upper edge (at the window sill) is attached by a series of retaining clips.

9. Once the panel is free, keep it close to the door and check

10 BODY

w/ Ventilator Window Type



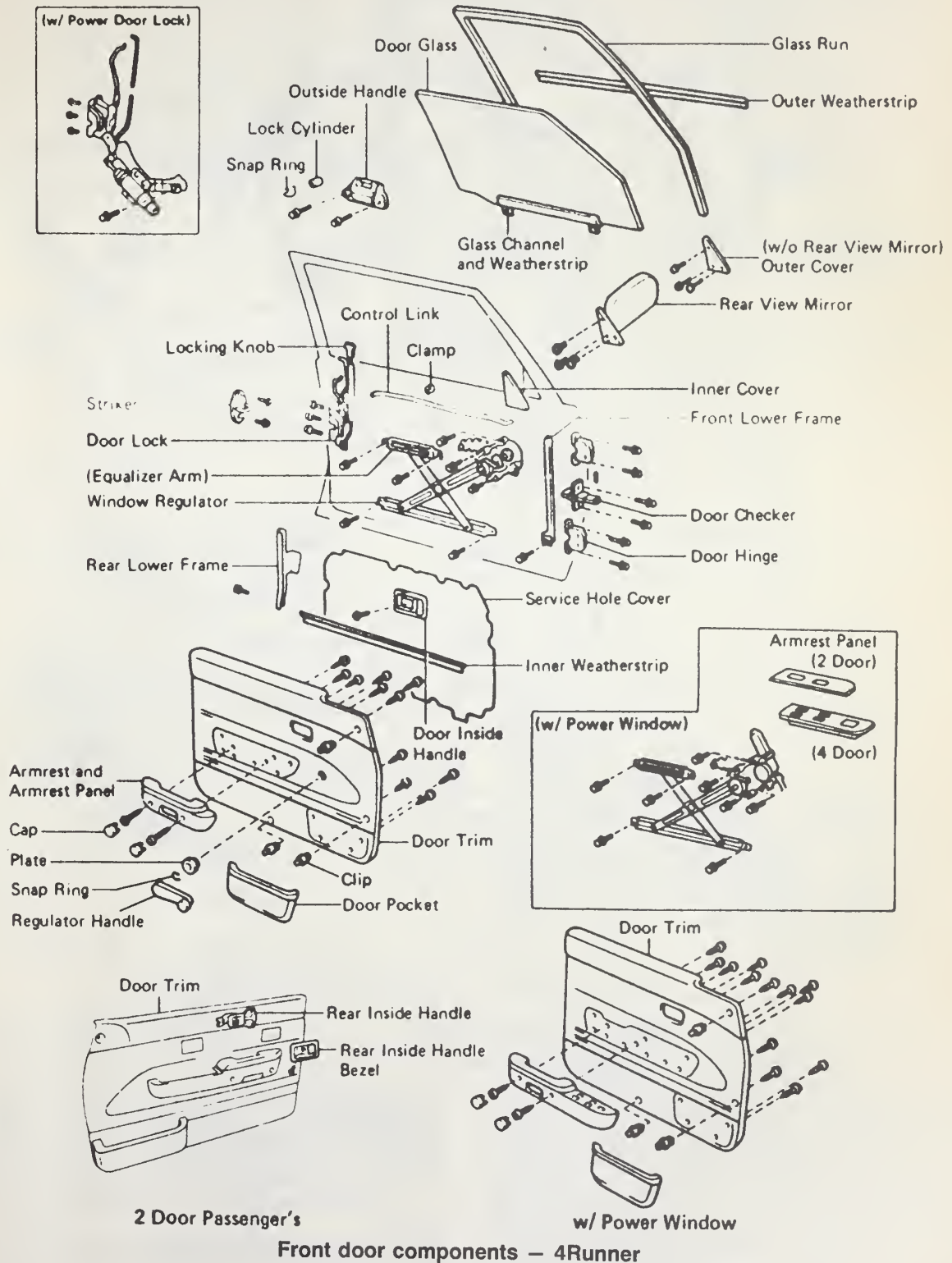
Semi Trim Type

w/ Wide Armrest

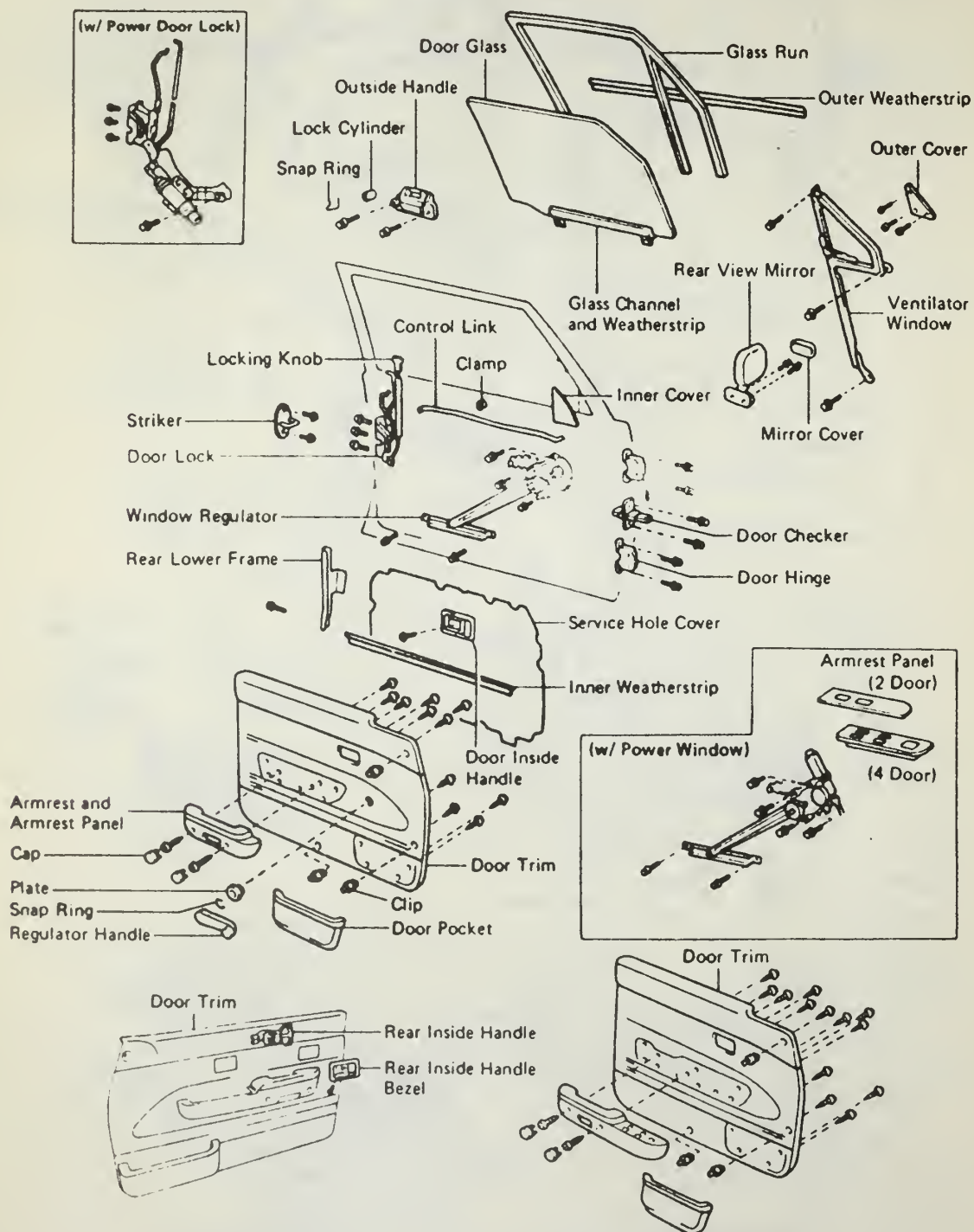
w/ Power Window

Front door components — Truck

w/o Ventilator Window Type



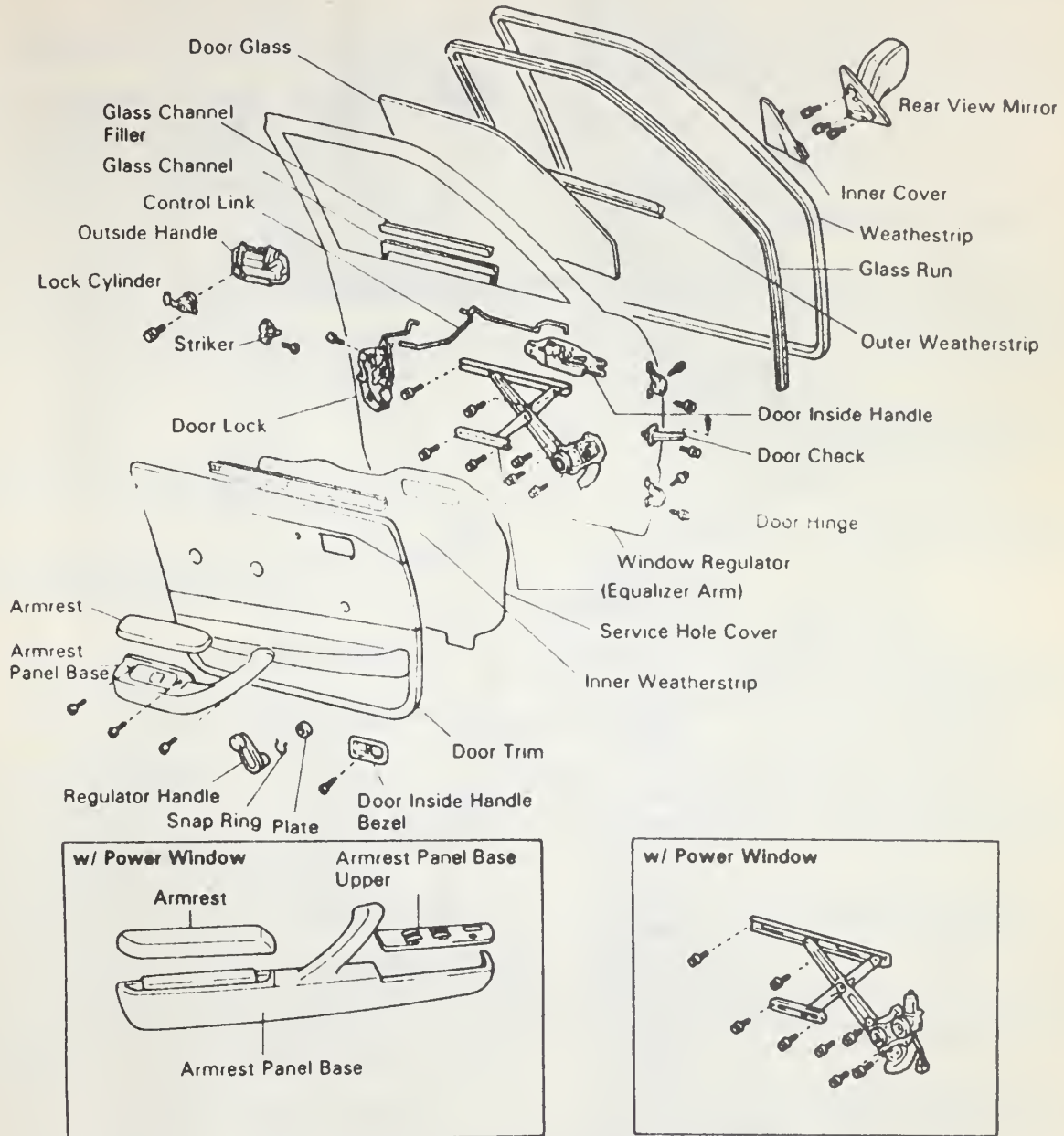
w/ Ventilator Window Type



2 Door Passenger's

w/ Power Window

Front door components — 4Runner



Front door components — 1991 Land Cruiser

behind it. Disconnect any wiring for switches, lights or speakers which may be attached.

NOTE: Behind the panel is a plastic or paper sheet taped or glued to the door. This is a water shield and must be intact to prevent water entry into the car. It must be securely attached at its edges and not be ripped or damaged. Small holes or tears can be patched with waterproof tape applied to both sides of the liner.

10. When reinstalling, connect any wiring harnesses and align the upper edge of the panel along the top of the door first. Make sure the left-right alignment is correct; tap the top of the panel into place with the heel of your hand.

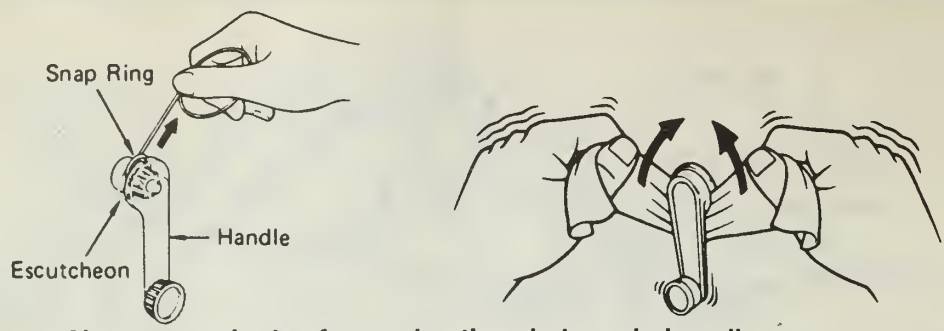
11. Make sure the plastic clips align with their holes; pop each retainer into place with gentle pressure.

12. Install the armrest and door handle bezel, remembering to install any caps or covers over the screws.

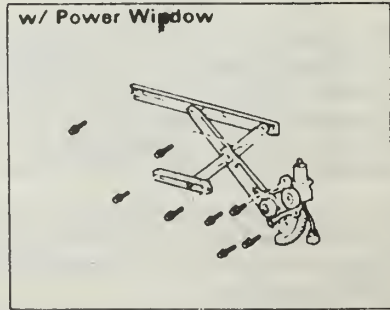
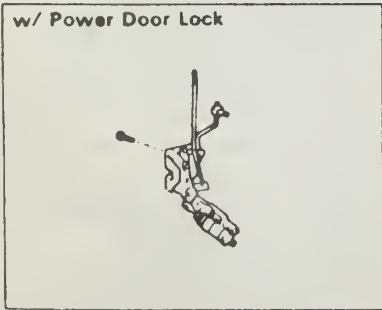
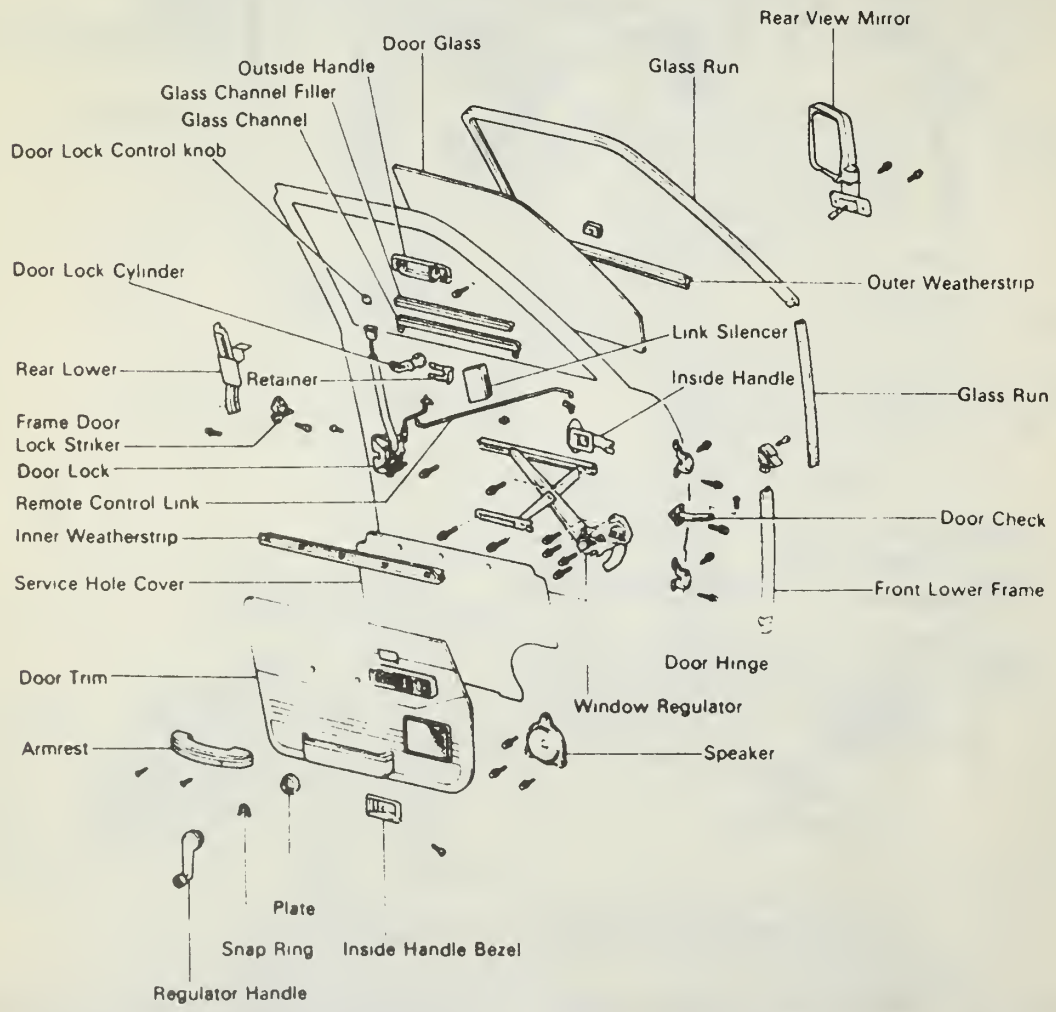
13. Install the window winder handle on vehicles with manual windows. Place the spring clip into the slot on the handle, remembering that the legs should point along the long dimension of the handle. Align the handle with the tape mark made earlier and put the winder over the end of the axle. Use the heel of your hand to give the center of the winder a short, sharp blow. This will cause the winder to move inward and the spring will engage its locking groove. The secret to this trick is to push the winder straight on; if it's crooked, it won't engage and you may end up looking for the spring clip.

14. Install any remaining parts or trim pieces which may have been removed earlier. (Map pockets, speaker grilles, etc.)

15. Install the delta cover and the remote mirror handle if they were removed.



Alternate methods of removing the window winder clip



Front door components — 1989-90 Land Cruiser

Door Locks

REMOVAL AND INSTALLATION

1. Remove the door trim panel and the inner water shield.
2. Disconnect the:
 - a. inside locking control link
 - b. outside opening control link
 - c. outside locking control link.
3. Remove the door lock cylinder with a pair of pliers.

To install:

4. Install the lock cylinder and connect the links.
5. Loosen the mounting screws for the inside door handle and push it forward until resistance is felt. Move it backwards slightly and tighten the mounting screws.
6. Disconnect the control link from the outside door handle about 1mm from rest. Turn the adjuster on the link until it will fit into the mounting hole of the raised handle.

Door Lock Cylinder

1. Place the window in the UP position.
2. Remove the trim panel and watershield.
3. Disconnect the actuating rod from the lock control link clip.
4. Slide the retainer away from the lock cylinder.
5. Pull the cylinder from the door.
6. Installation is the reverse of removal.

Door Glass and Regulator

REMOVAL AND INSTALLATION

Glass without Vent Window

1. Lower the window.
2. Remove the door trim panel and the water shield.
3. Remove the armrest base and the inside door handle.
4. Remove the inner and outer weatherstrips.
5. Remove the 2 door glass channel mounting bolts and pull the window up and out of the door. Carefully pry the glass channel from the bottom of the window.
6. Coat the inside of the weather strip with soapy water and tap the glass channel onto the bottom of the window.
7. Slide the window into the door until the 2 glass channel mounting bolts can be fitted. Tighten the bolts.
8. Install the weather strips. Install the armrest base and inside door handle.
9. Install the water shield and the door trim panel.

Glass Wwith Vent Window

1. Lower the window.
2. Remove the door trim panel and the water shield.
3. Remove the armrest base and the inside door handle.
4. Remove the inner and outer weatherstrips.
5. Remove the glass run and the rear lower frame.
6. Remove the 2 glass channel mounting bolts and place the window on the bottom of the door cavity.
7. Peel off the weatherstrip on the upper side of the vent window. Remove the 3 screws and the division bar set bolt. Pull the vent window up and out of the door frame.
8. Pull the main window up and out of the door. Pry the glass channel from the bottom of the window.

To install:

9. Coat the inside of the weatherstrip with soapy water and carefully tap the glass channel onto the bottom of the window.
10. Slide the main window into the door until the 2 glass channel mounting bolts can be fitted.
11. Position the vent window and install the 3 mounting

screws and the set bolt. Tighten the 2 glass channel mounting bolts.

12. Install the weatherstrips. Install the armrest base and inside door handle.
13. Install the water shield and the door trim panel.

Regulator

1. Remove the door trim panel.
2. Remove the water shield.
3. Remove the window.
4. If the truck has power windows, disconnect the electrical lead from the motor.
5. Remove the regulator mounting bolts and lift it out through the service hole. On models without a vent window, remove the 2 equalizer arm bracket mounting bolts.
6. Install the regulator and tighten the mounting bolts. On models with a vent window, install the 2 equalizer arm bracket mounting bolts.
7. Connect the lead to the power window motor if equipped.
8. Install the window, water shield and door trim panel.

Tailgate Window

REMOVAL AND INSTALLATION

4Runner Only

POWER WINDOW OPERATIVE

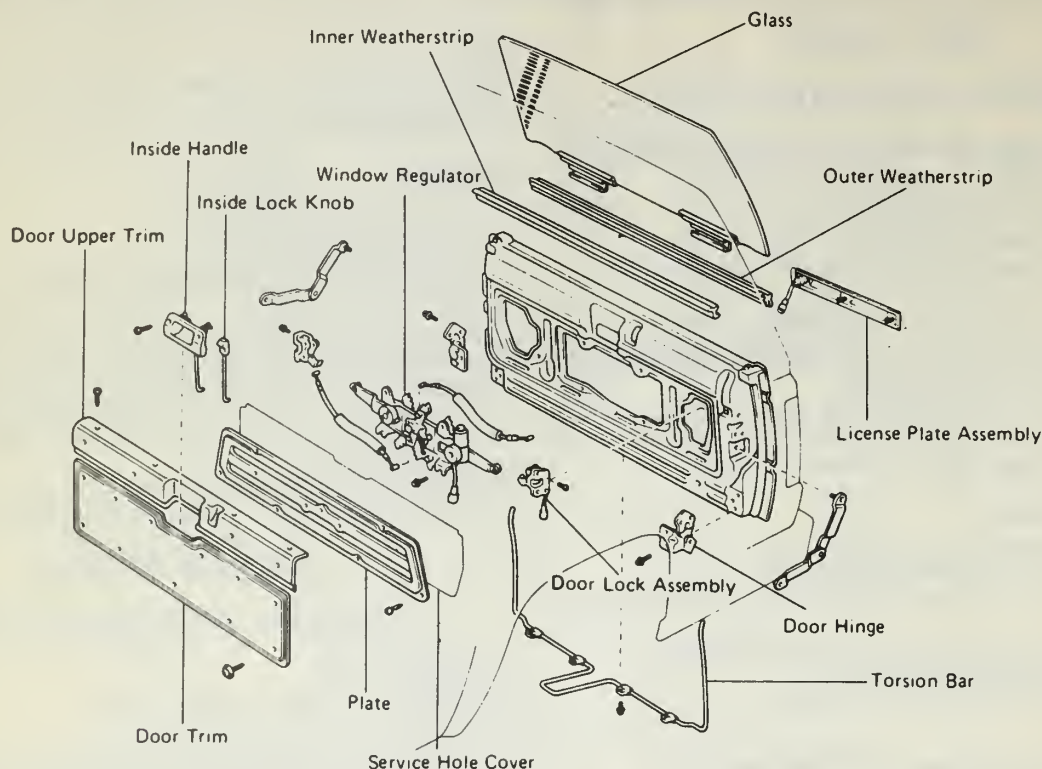
1. Remove the inner tailgate trim.
2. Remove the tailgate plate and the water shield.
3. Disconnect the control link for the inside handle at the regulator, remove the 2 mounting screws and lift out the door handle.
4. Disconnect the inside lock knob link at the regulator and remove the knob and link.
5. Remove the upper door trim and the weather stripping.
6. Move the locking assembly into the **LOCK** position and then raise the rear window until the regulator arms are in a straight line.
7. Disconnect the electrical lead at the regulator. Disconnect the leads for the rear defogger at the window.
8. Disconnect the door lock control cables at the regulator side. Disconnect the 2 remaining leads and the ground cable at the regulator.
9. Remove the 3 regulator mounting bolts and then shimmy it side-to-side until the arms pull away from the glass.
10. Pull out the rear window and remove the regulator.

To install:

11. Slide the window into the tailgate.
12. Shimmy the regulator side-to-side until the arms position themselves in the glass channel and then install the regulator mounting bolts.
13. Connect the rear defogger leads to the window. Connect the 2 leads and the ground cable at the regulator.
14. Use the original clamps and connect the door lock control cables to the regulator.
15. Connect the power lead to the regulator.
16. Install the upper tailgate trim and weather stripping.
17. Install the inside lock knob and link.
18. Install the inside handle and connect the control link to the regulator.
19. Seal the water shield with butyl tape (6mm), insert the lower edge into the panel slit and then seal the slit with cotton tape being careful not to block the trim clip seats.
20. Install the plate and lower tailgate trim.

POWER WINDOW INOPERATIVE

1. Remove the inner tailgate trim.
2. Remove the tailgate plate and the water shield.
3. Disconnect the control link for the inside handle at the reg-



ulator, remove the 2 mounting screws and lift out the door handle.

4. Disconnect the inside lock knob link at the regulator and remove the knob and link.

5. Remove the upper door trim and the weather stripping.

6. Disconnect the power lead, 2 electrical leads and the ground cable at the regulator.

7. Disconnect the door lock control cables at the regulator.

8. Remove the mounting bolts and lift out the regulator motor. Someone MUST hold the rear window while removing the regulator motor.

9. Lower the rear window all the way and open the door by pulling on the control cables. Raise the window until the regulator arms are horizontal and install a small pin into the service hole in the regulator to secure the arms.

10. Disconnect the rear defogger leads at the window.

11. Remove the regulator mounting bolts, slide the regulator side-to-side until the arms pull out of the window channel and then lift out the regulator.

12. Lift out the rear window.

To install:

13. Slide the window into the tailgate.

14. Shimmy the regulator side-to-side until the arms position themselves in the glass channel and then install the regulator mounting bolts.

15. Connect the rear defogger leads to the window. Connect the 2 leads and the ground cable at the regulator.

16. Use the original clamps and connect the door lock control cables to the regulator.

17. Connect the power lead to the regulator.

18. Install the upper tailgate trim and weather stripping.

19. Install the inside lock knob and link.

20. Install the inside handle and connect the control link to the regulator.

21. Seal the water shield with butyl tape (6mm), insert the lower edge into the panel slit and then seal the slit with cotton tape being careful not to block the trim clip seats.

22. Install the plate and lower tailgate trim.

Front Windshield

REMOVAL AND INSTALLATION

1989-90 Land Cruisers, all 4Runners and certain trucks use a glue-in windshield. Special adhesives, primers and cleaners must be used; the integrity and water seal of the glass depends entirely on the installation. Removal and replacement of this type of windshield is generally not within the ability of the owner/mechanic; a slight error can result in a water leak or a shattered windshield. Additionally, adhesive-mounted windshields add strength to the roof and pillars if the vehicle rolls over so a poor installation has safety implications as well.

Replacement of this type of glass is best referred to an installer. In many cases, the vehicle is returned clean and ready the same day.

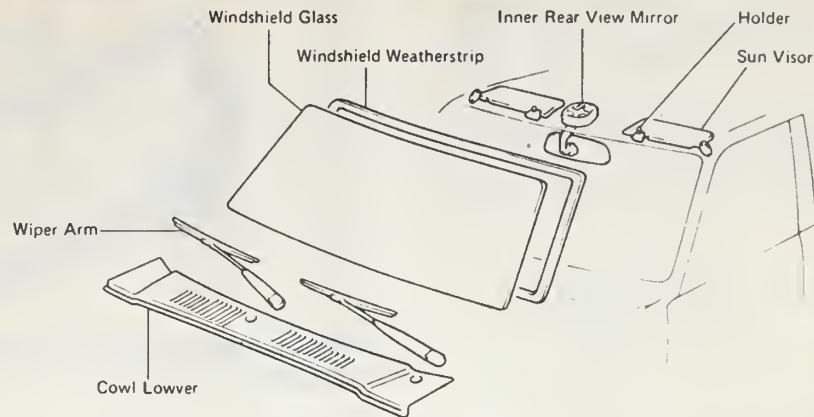
Truck Windshield with Weatherstrip

An assistant and the following equipment is required. Have it present before beginning the procedure.

- Weatherstrip cleaner
- Weatherstrip primer; Union Carbide AP131 or equivalent
- Primer solvent: Toluene — see caution below
- Weatherstrip adhesive; Cemedine 366ET, DuPont Imron Sealant or equivalent
- Piano wire or other thin, strong wire
- Two hand-sized blocks of wood
- Sash cord or thin clothesline
- A small amount of clean kerosene

CAUTION

The chemicals and solvents in use are flammable and create vapors which may explode if exposed to heat, sparks or flame. Additionally, the vapors may be toxic or cause allergic reactions. Work only in an open, well-ventilated area and avoid exposure to fumes. Keep containers capped at all times when not in use. Wear rubber gloves and eye protection when chemicals are in use.



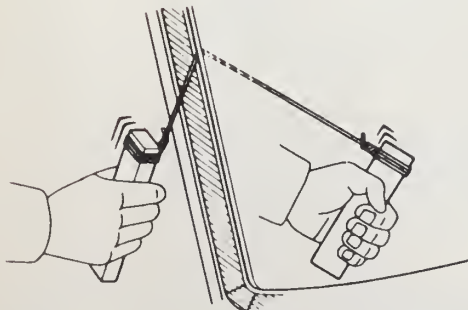
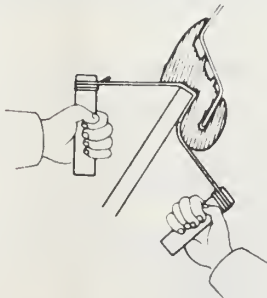
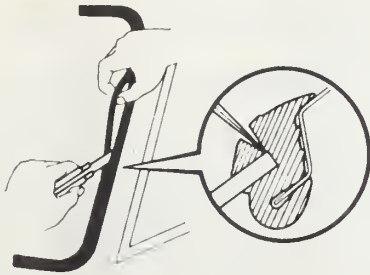
Weatherstrip windshield — Truck

1. Remove the sun visors, holders, inside mirror, wiper arms and the cowl cover at the base of the windshield.

2. On the outside, use a sharp tool to cut off the lip of the weatherstrip that overlaps the glass. Do not damage the bodywork or paint.

3. Push a piece of piano wire through from the inside.

4. Tie the ends of the wire securely to the wood blocks, one inside and one outside.



Steps in removing the windshield

5. Place a piece of plastic on the dash to protect the vinyl and trim. Move the plastic along as the wood and wire is pulled.

6. Cut the adhesive holding the weatherstrip by pulling on the wood handles and moving around the windshield. An assistant inside makes this a lot easier. Exercise great care not to damage interior or exterior trim or paintwork.

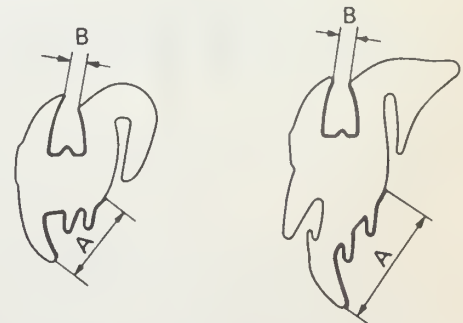
7. When the adhesive has been cut all the way around, remove the windshield by pressing gently from the inside. If the windshield is to be reused, store it out of the work area in a safe location; protect it with blankets or pads.

8. If the glass is to be reinstalled, use a scraper to remove the adhesive. Clean the glass with glass cleaner.

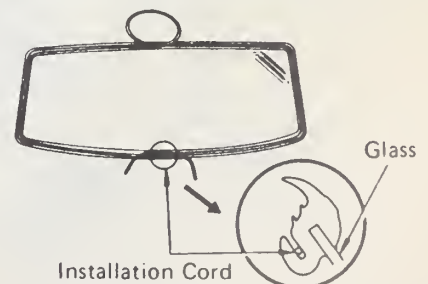
To install:

9. Use the weatherstrip cleaner to clean the contact surfaces of the body and the glass.

10. Saturate a piece of cloth with cleaner. Clean the weatherstrip surfaces with particular attention to getting all the way to the bottom of the grooves and completely cleaning the sides of the channels. Allow the primer to dry for at least 3 minutes; longer is better.



Areas A and B must be carefully cleaned and primed



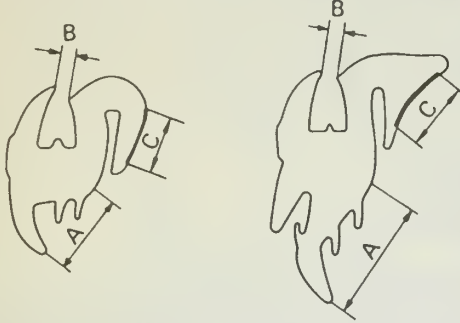
The installation cord helps fit the weatherstrip over the body flanges

10 BODY

11. Coat the contact surfaces of the weather strip (the channels) with the primer; allow the primer to dry at least 15 minutes. Be careful not to touch the coated portions of the weatherstrip.

12. Attach the weatherstrip to the windshield. Install a length of rope around the weatherstrip. Provide a loop at the top and overlap the ends at the bottom.

13. Coat area C of the weatherstrip with clean kerosene. Do not use soapy water.



Coat area C only with kerosene before installation

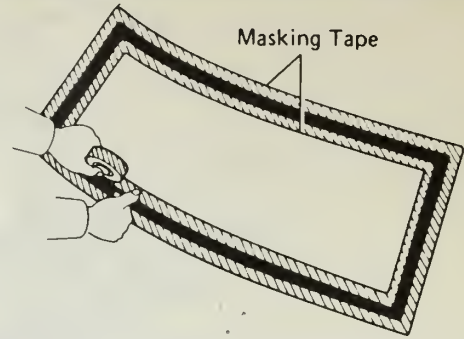
14. Hold the glass in position on the body. Begin installation in the middle of the lower part of the glass.

15. From the inside, pull on one cord (at an angle) so that it will pass over the flange. From the outside, tap the glass along the weatherstrip with open hands until the glass is installed. Continue pulling on the cord around the glass.

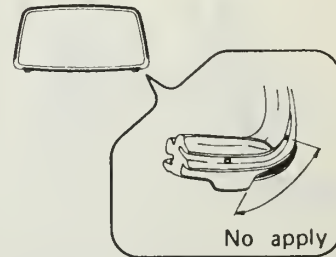
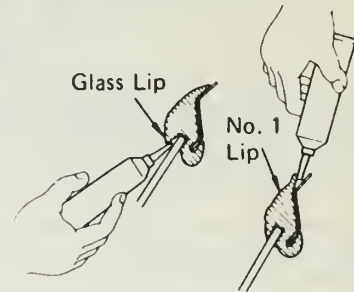
16. Snug the glass by tapping from the outside with open palms.



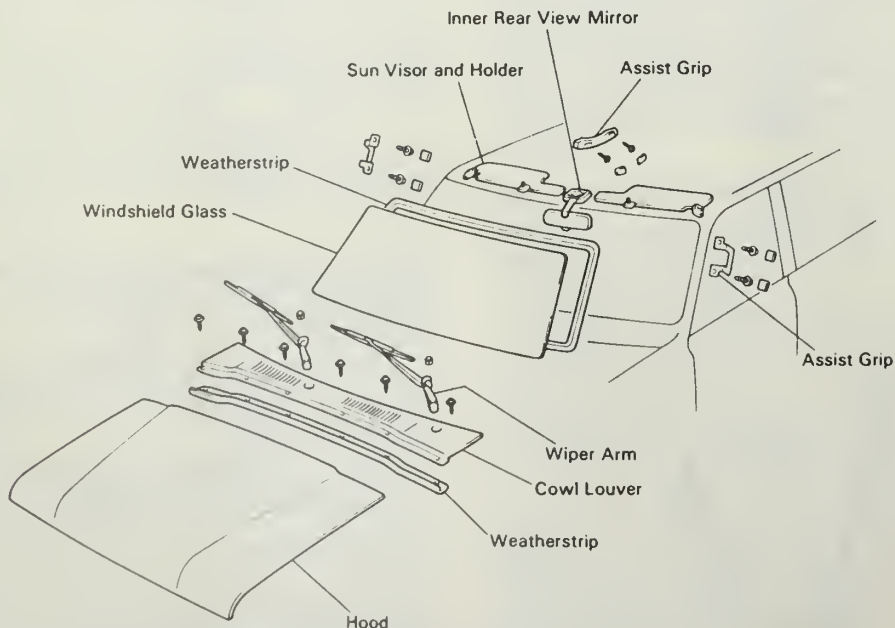
Installation is a 4-handed procedure



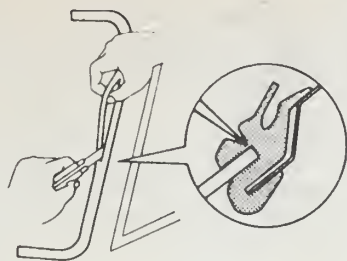
Double layers of masking tape protect the bodywork and glass



Apply sealant only in the correct areas



Weatherstrip windshield — Land Cruiser



Steps In removing the windshield

17. Place masking tape above the outer edge of the weatherstrip all around. Place a second layer of tape on the glass, inboard of the weatherstrip.

18. Apply adhesive all around at the glass lip at the weatherstrip until it oozes out. Apply adhesive to the weatherstrip-to-body lip all around EXCEPT at the lower corner sections until it oozes out.

19. The adhesive will harden in about 15 minutes, depending on temperature. When the adhesive is dry, remove the masking tape. Use a rag soaked in cleaner to remove the excess adhesive.

20. Allow the adhesive to set for an hour. Water test the windshield for leaks. Seal any leaks with adhesive (dry the area first).

21. Install the cowl cover, wiper arms, inside mirror, sun visors and holders.

Land Cruiser Windshield with Weatherstrip

1. Before beginning work, make certain that a supply of automotive glass sealer and cleaner is on hand. Additionally, a length of piano wire or similar strong wire and two hand-sized blocks of wood are required. Have an assistant available.

2. Remove the hood.

3. Remove the wiper arms and the cowl cover.

4. Remove the inside mirror, the sun visors and holders and the hand grips.

5. On the outside, use a sharp tool to cut off the lip of the weatherstrip that overlaps the glass. Do not damage the bodywork or paint.

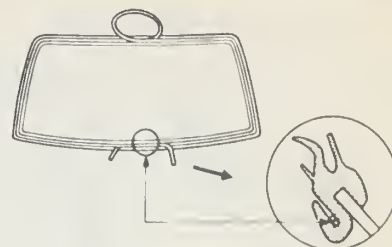
4. Push a piece of piano wire through from the inside.

5. Tie the ends of the wire securely to the wood blocks, one inside and one outside.

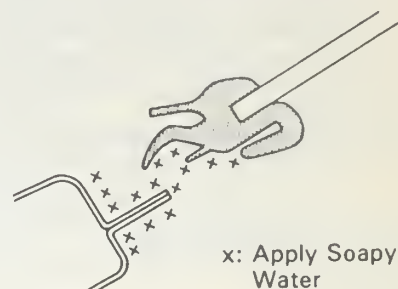
6. Place a piece of plastic on the dash to protect the vinyl and trim. Move the plastic along as the wood and wire is pulled.

7. Cut the adhesive holding the weatherstrip by pulling on the wood handles and moving around the windshield. An assistant inside makes this a lot easier. Exercise great care not to damage interior or exterior trim or paintwork.

8. When the adhesive has been cut all the way around, remove the windshield by pressing gently from the inside. If the windshield is to be reused, store it out of the work area in a safe location; protect it with blankets or pads.



Carefully Install the Installation cord



x: Apply Soapy Water

Lubricate the areas shown



An assistant is required during installation

9. If the glass is to be reinstalled, use a scraper to remove the adhesive. Clean the glass with glass cleaner.

To install:

10. Use the cleaner to clean the contact surfaces of the body and the glass.

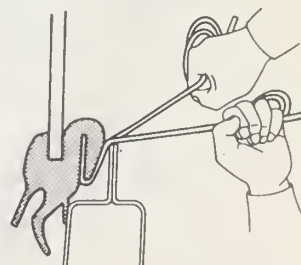
11. Attach the weatherstrip to the windshield. Install a length of rope around the weatherstrip. Provide a loop at the top and overlap the ends at the bottom.

12. Apply soapy water to the contact surface of the weatherstrip lip and to the body flange.

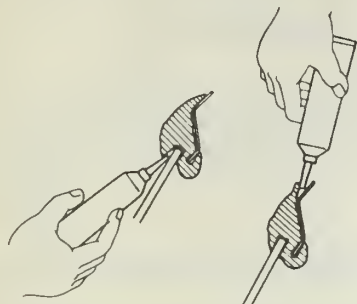
13. Hold the glass in position on the body. Begin installation in the middle of the lower part of the glass.

14. From the inside, pull on one cord (at an angle) so that it will pass over the flange. From the outside, tap the glass along the weatherstrip with open hands until the glass is installed. Continue pulling on the cord around the glass.

15. Snug the glass by tapping from the outside with open palms.



Pull the rope on an angle (upper) so it does not bind on the flange



Apply glass sealant as shown.

17. Place masking tape above the outer edge of the weatherstrip all around. Place a second layer of tape on the glass, in-board of the weatherstrip.

18. Apply sealer all around at the glass lip at the weatherstrip until it oozes out. Apply sealer to the weatherstrip-to-body lip all around.

19. When the sealer is dry, remove the masking tape. Use a rag soaked in cleaner to remove the excess.

20. Water test the windshield for leaks. Seal any leaks with sealer (dry the area first).

21. Install the hood.

22. Install the cowl cover, wiper arms, inside mirror, sun visors, holders and assist handles

Rear Quarter Window And Rear Windshield

REMOVAL AND INSTALLATION

Pickup Only

NOTE: You'll need an assistant for this job.

1. Have your assistant stand outside and support the glass.
2. Working from the inside truck, start at one upper corner and work the weatherstripping across the top of the glass, pulling the weatherstripping down and pushing outward on the glass until your assistant can grab the glass and lift it out.
3. Remove the moldings.
4. Remove the weatherstripping from the glass.

To install:

5. Clean the weatherstripping, glass and glass opening with solvent to remove all old sealer.

6. Apply liquid butyl sealer in the glass channel of the weatherstripping and install the weatherstripping on the glass.

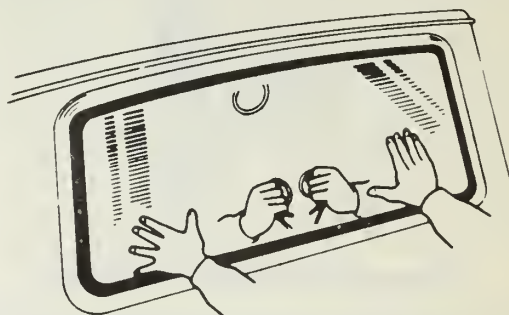
7. Install the moldings.

8. Apply a bead of sealer to the opening flange and in the inner flange crevice of the weatherstripping lip.

9. Place a length of strong cord, such as butcher's twine, in the flange crevice of the weatherstripping. The cord should go all the way around the weatherstripping with the ends, about 18 in. (457mm) long each, hanging down together at the bottom center of the window.

10. Apply soapy water to the weatherstripping lip.

11. Have your assistant position the window assembly in the channel from the outside, applying firm inward pressure.



Use a cord to aid installation of the weatherstrip and window

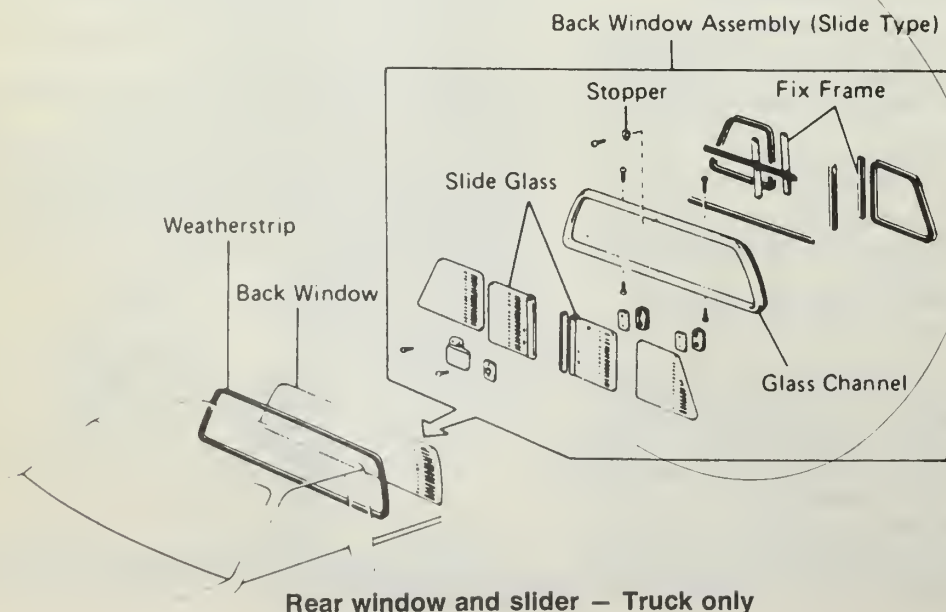
12. From inside, you guide the lip of the weatherstripping into place using the cord, working each end alternately, until the window is locked in place.

13. Remove the cord, clean the glass and weatherstripping of excess sealer and leak test the window.

DISASSEMBLY

Pickup With Sliding Rear Windows

1. Remove the rear windshield.
2. Remove the sliding glass stopper from the window frame.



Rear window and slider — Truck only

3. Remove the mounting screws for the 2 center support frames.

4. While pulling the upper and lower window frame apart, slide the glass into the center of the window and remove each sliding pane from the frame.

5. Pull apart the upper and lower frame again and remove the 2 center supports. Slide the stationary glass into the center of the frame and remove it. Repeat for the other side.

6. Coat the mating surfaces of the window frame and the weather stripping with soapy water and slide the 2 stationary window halves into position.

7. Install the 2 center support frames.

8. Install the sliding glass halves, tighten the center frame mounting screws and install the window stopper.

9. Install the entire assembly.

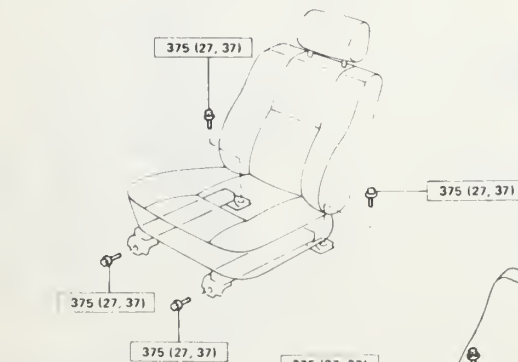
Front Bucket, Bench and Split Bench Seats

REMOVAL AND INSTALLATION

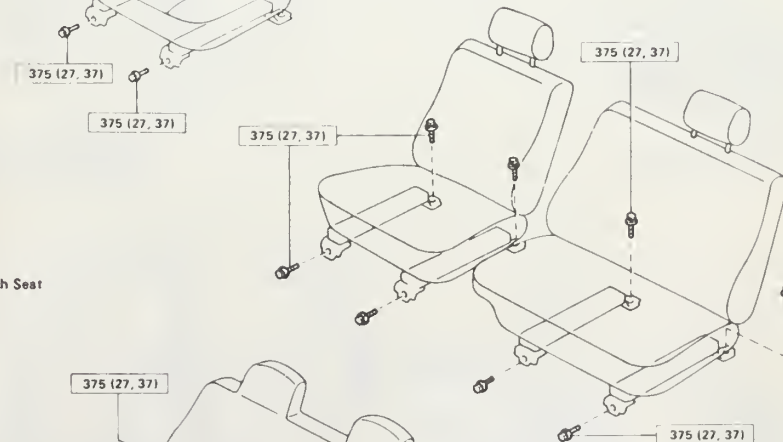
1. Remove the seat track-to-floor pan bolts and lift out the seat.

2. Apply sealer to the hole areas and install the seat. Tighten the bolts to 27 ft. lbs. (37 Nm) for Trucks and 4Runners. Tighten Land Cruiser seat bolts to 29 ft. lbs. (39 Nm).

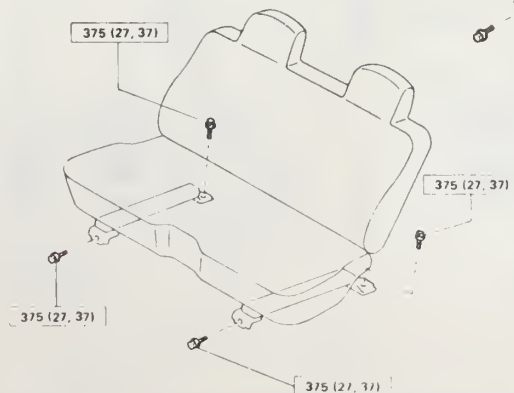
Separate Seat



Bench Seat



Sprit Bench Seat



Front seats — Truck

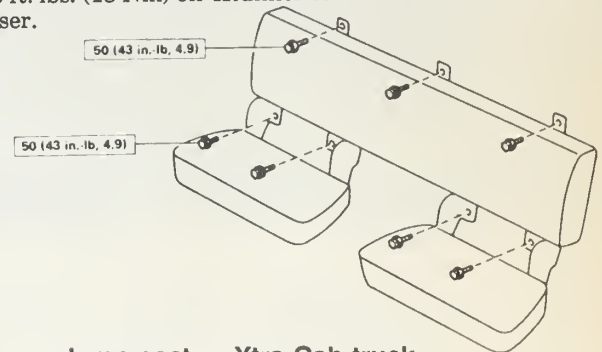
Rear Bench Seat

REMOVAL AND INSTALLATION

1. Release the seat back locks on each side of the seat.

2. Remove the covers and remove the bolts holding the front of the seat bottom to the floor pan. On 4Runner, doing this removes only the seat bottom. Remove the seat back by removing the center hinge bolts and the pivot bolts at either side. Remove the seat and seat back.

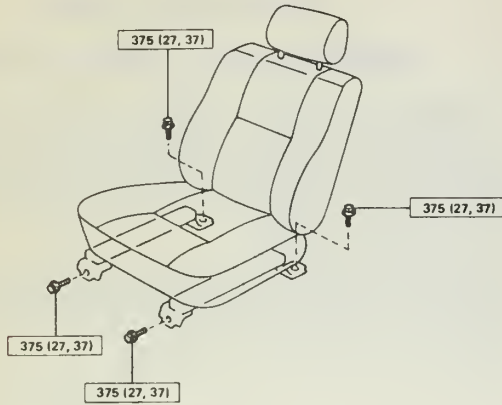
3. Apply sealer to the hole areas and install the seat and back. Tighten the bolts. Tighten the bolts holding the seat to the floor to 13 ft. lbs. (18 Nm) on 4Runner or 29 ft. lbs. (39 Nm) on Land Cruiser.



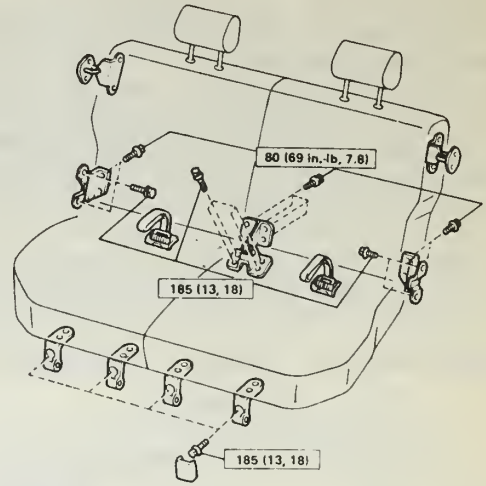
Jump seat — Xtra Cab truck

10 BODY

Front Seat



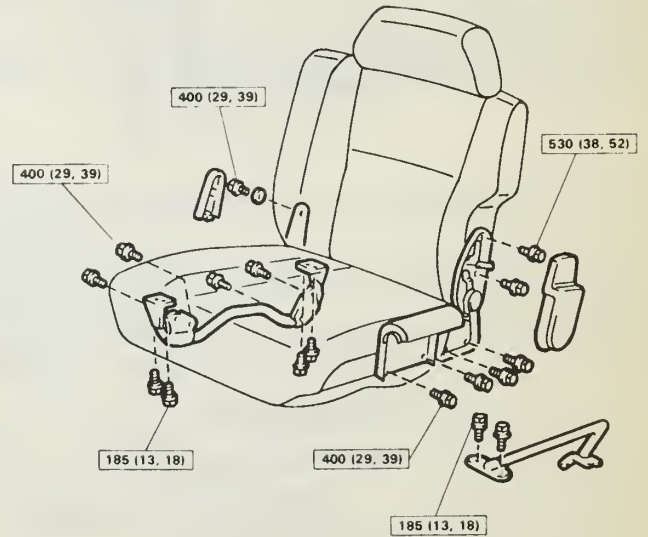
Rear Seat



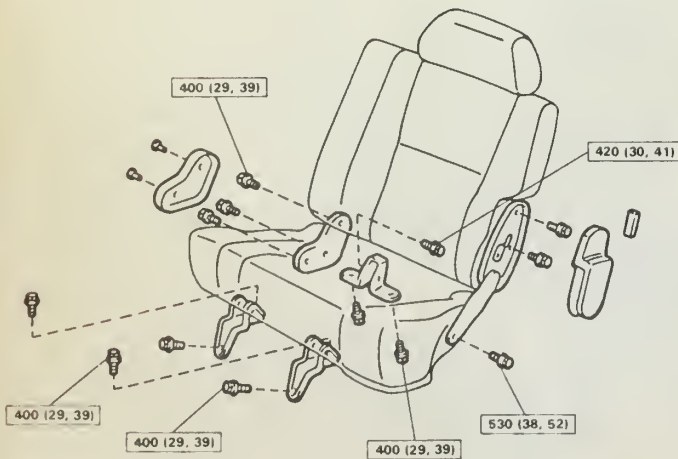
Front and rear seats – 4Runner



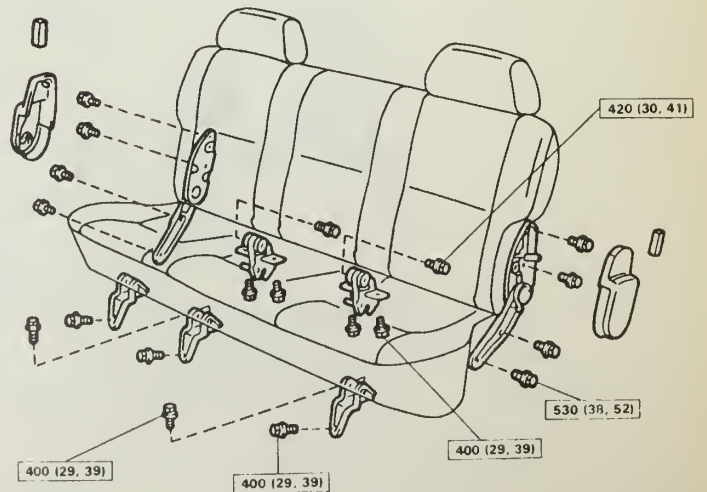
Land Cruiser front seat



Land Cruiser third seat



Land Cruiser second seat



Seat Belts

TESTING

Automatic Retracting Belts

The retracting seat belts used in Toyota vehicles may be tested for function without removal. The spools rely on an internal pendulum mechanism to lock under sudden deceleration or impact. The old test of pulling sharply on the belt will not cause it to lock; it must be tested with the vehicle in motion.

Fasten the seat belt while in your normal driving position. The belt should be snug against your chest and lap. In a safe location, drive the vehicle at about 10 mph. Apply the brakes very hard; the belt should lock and restrain you in the seat.

To test lap belts, simply connect the buckle (as it would be in use) and apply firm force to either side of the belt. There should be no slippage of the belt through the adjuster.

REMOVAL AND INSTALLATION

Seat belts are a safety item; the continued success of your face (and the rest of you) depends on the proper removal and installation of the belt assemblies. Use only wrenches of the correct

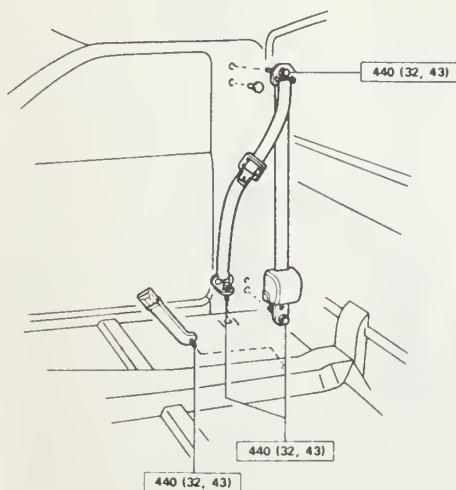
size. Observe torque specifications carefully. Never substitute bolts when reinstalling; seat belt retaining bolts are of specific sizes and materials. Make certain every washer, shim, etc., is reinstalled exactly as it was.

Seat belt removal is simple once you get to the bolts. Removal of seats, interior panels and possibly the carpet will be required depending on the belt. Removing interior panels can turn into a major project, since panels adjoin and overlap. Be very careful during panel removal not to damage the clips and hardware holding the panel. Never force or pry a panel that won't come loose. Instead, look for the hidden clip or screw. If necessary, diagram the placement of clips and retainers. When reassembling, take the time to fit every retainer and align the panel correctly. The one you skip will cause a squeak on every bump.

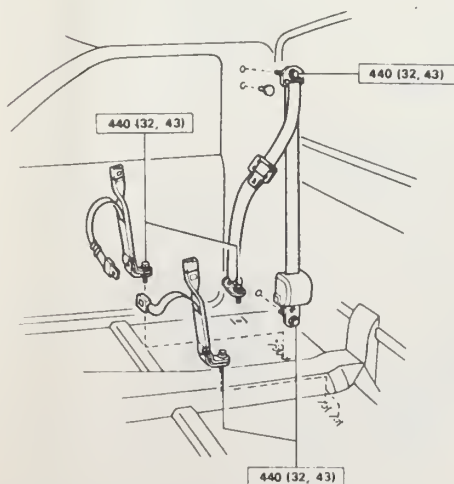
Lap belt halves are generally bolted to the floorpan or center hump. If removing front lap belts, disconnect the wiring connector at the bottom of the buckle half before removing the retaining bolt. Retractor belts are bolted at both the floor and to a pillar or roof rail. Again, front belts will have a connector at the winder; disconnect it before removal.

When reinstalling, make certain the belt brackets are squarely placed and that the belt is not twisted or backwards. Check the extension and retraction of belts before final tightening any bolts.

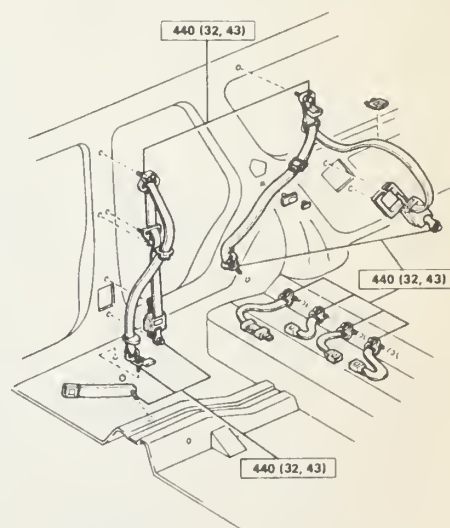
Separate Seat



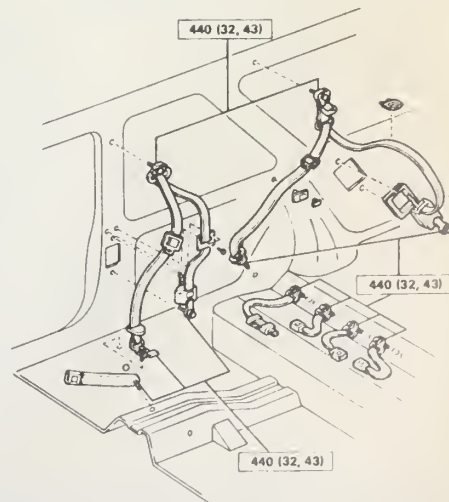
Sprit Bench Seat and Bench Seat



4 Door



2 Door

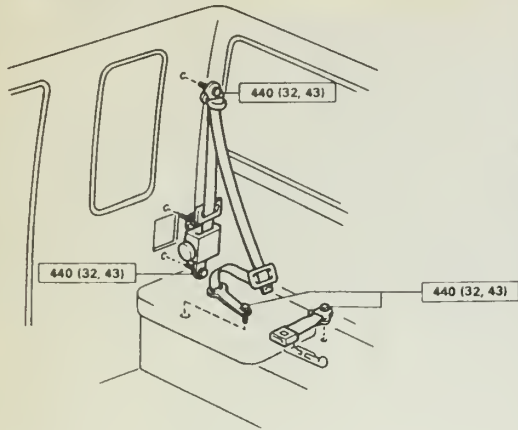


kg cm (ft. lb, N m) Specified torque

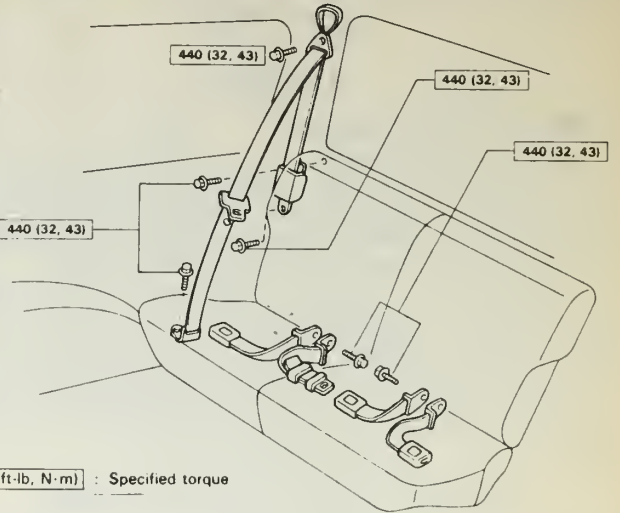
Seat belt components — Truck

Seat belt components — 4Runner

10 BODY



kg-cm (ft-lb, N-m) : Specified torque

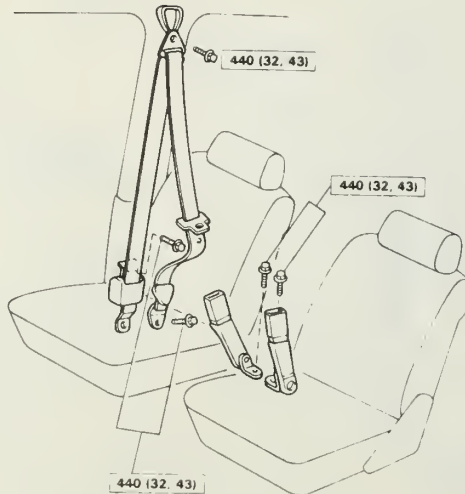


kg-cm (ft-lb, N-m) : Specified torque

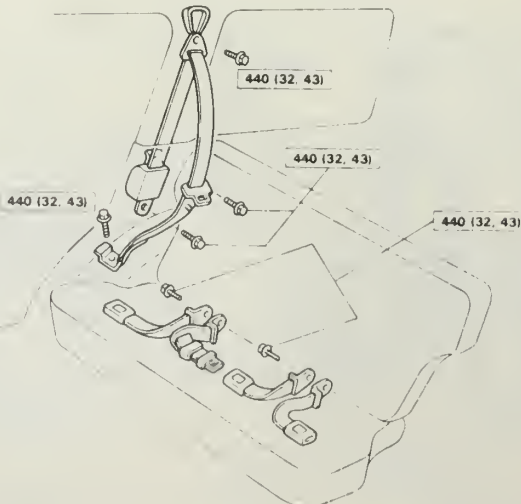
Xtra Cab jump seat belt components

Land Cruiser third seat belt components

Front Seat Belt

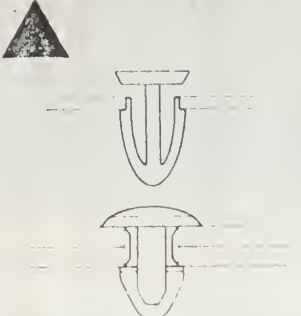
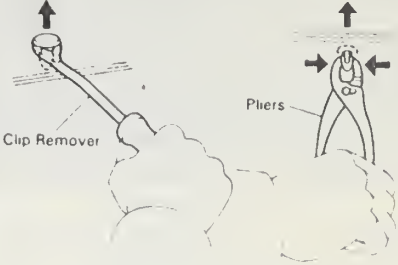
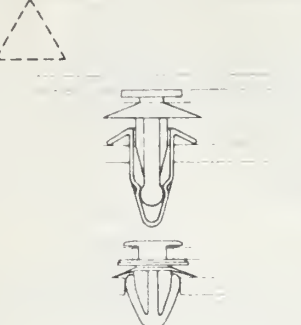
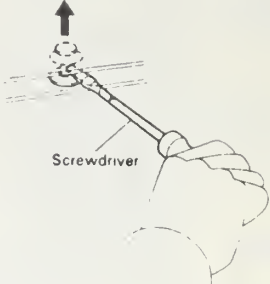
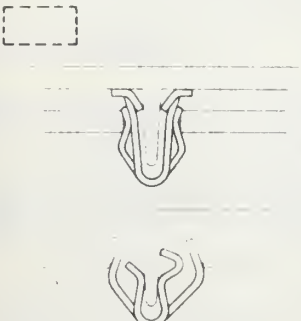
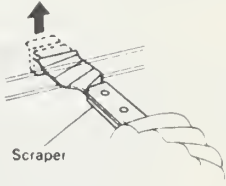
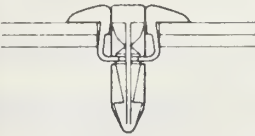
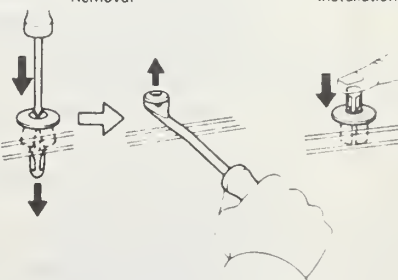
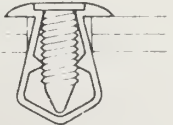
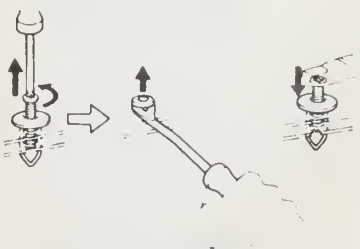


Second Seat Belt



kg cm (ft lb, N-m) : Specified torque

Land Cruiser front and rear seat belts

Shape (Example)	Removal/Installation
	
	
	
	
	

Examples of typical body fasteners used on panels and trim pieces. Note the use of protected tools during removal.

Hood, Trunk Lid, Hatch Lid, Glass and Doors

Problem	Possible Cause	Correction
HOOD/TRUNK/HATCH LID		
Improper closure.	• Striker and latch not properly aligned.	• Adjust the alignment.
Difficulty locking and unlocking.	• Striker and latch not properly aligned.	• Adjust the alignment.
Uneven clearance with body panels.	• Incorrectly installed hood or trunk lid.	• Adjust the alignment.
WINDOW/WINDSHIELD GLASS		
Water leak through windshield	• Defective seal. • Defective body flange.	• Fill sealant • Correct.
Water leak through door window glass.	• Incorrect window glass installation. • Gap at upper window frame.	• Adjust position. • Adjust position.
Water leak through quarter window.	• Defective seal. • Defective body flange.	• Replace seal. • Correct.
Water leak through rear window.	• Defective seal. • Defective body flange.	• Replace seal. • Correct.
FRONT/REAR DOORS		
Door window malfunction.	• Incorrect window glass installation. • Damaged or faulty regulator.	• Adjust position. • Correct or replace.
Water leak through door edge.	• Cracked or faulty weatherstrip.	• Replace.
Water leak from door center.	• Drain hole clogged. • Inadequate waterproof skeet contact or damage.	• Remove foreign objects. • Correct or replace.
Door hard to open.	• Incorrect latch or striker adjustment.	• Adjust.
Door does not open or close completely.	• Incorrect door installation. • Defective door check strap. • Door check strap and hinge require grease.	• Adjust position. • Correct or replace. • Apply grease.
Uneven gap between door and body.	• Incorrect door installation.	• Adjust position.
Wind noise around door.	• Improperly installed weatherstrip. • Improper clearance between door glass and door weatherstrip. • Deformed door.	• Repair or replace. • Adjust. • Repair or replace.

Glossary

AIR/FUEL RATIO: The ratio of air to gasoline by weight in the fuel mixture drawn into the engine.

AIR INJECTION: One method of reducing harmful exhaust emissions by injecting air into each of the exhaust ports of an engine. The fresh air entering the hot exhaust manifold causes any remaining fuel to be burned before it can exit the tailpipe.

ALTERNATOR: A device used for converting mechanical energy into electrical energy.

AMMETER: An instrument, calibrated in amperes, used to measure the flow of an electrical current in a circuit. Ammeters are always connected in series with the circuit being tested.

AMPERE: The rate of flow of electrical current present when one volt of electrical pressure is applied against one ohm of electrical resistance.

ANALOG COMPUTER: Any microprocessor that uses similar (analogous) electrical signals to make its calculations.

ARMATURE: A laminated, soft iron core wrapped by a wire that converts electrical energy to mechanical energy as in a motor or relay. When rotated in a magnetic field, it changes mechanical energy into electrical energy as in a generator.

ATMOSPHERIC PRESSURE: The pressure on the Earth's surface caused by the weight of the air in the atmosphere. At sea level, this pressure is 14.7 psi at 32°F (101 kPa at 0°C).

ATOMIZATION: The breaking down of a liquid into a fine mist that can be suspended in air.

AXIAL PLAY: Movement parallel to a shaft or bearing bore.

BACKFIRE: The sudden combustion of gases in the intake or exhaust system that results in a loud explosion.

BACKLASH: The clearance or play between two parts, such as meshed gears.

BACKPRESSURE: Restrictions in the exhaust system that slow the exit of exhaust gases from the combustion chamber.

BAKELITE: A heat resistant, plastic insulator material commonly used in printed circuit boards and transistorized components.

BALL BEARING: A bearing made up of hardened inner and outer races between which hardened steel balls roll.

BALLAST RESISTOR: A resistor in the primary ignition circuit that lowers voltage after the engine is started to reduce wear on ignition components.

BEARING: A friction reducing, supportive device usually located between a stationary part and a moving part.

BIMETAL TEMPERATURE SENSOR: Any sensor or switch made of two dissimilar types of metal that bend when heated or cooled due to the different expansion rates of the alloys. These types of sensors usually function as an on/off switch.

BLOWBY: Combustion gases, composed of water vapor and unburned fuel, that leak past the piston rings into the crankcase during normal engine operation. These gases are removed by the PCV system to prevent the buildup of harmful acids in the crankcase.

BRAKE PAD: A brake shoe and lining assembly used with disc brakes.

BRAKE SHOE: The backing for the brake lining. The term is, however, usually applied to the assembly of the brake backing and lining.

BUSHING: A liner, usually removable, for a bearing; an anti-friction liner used in place of a bearing.

BYPASS: System used to bypass ballast resistor during engine cranking to increase voltage supplied to the coil.

CALIPER: A hydraulically activated device in a disc brake system, which is mounted straddling the brake rotor (disc). The caliper contains at least one piston and two brake pads. Hydraulic pressure on the piston(s) forces the pads against the rotor.

CAMSHAFT: A shaft in the engine on which are the lobes (cams) which operate the valves. The camshaft is driven by the crankshaft, via a belt, chain or gears, at one half the crankshaft speed.

CAPACITOR: A device which stores an electrical charge.

CARBON MONOXIDE (CO): A colorless, odorless gas given off as a normal byproduct of combustion. It is poisonous and extremely dangerous in confined areas, building up slowly to toxic levels without warning if adequate ventilation is not available.

CARBURETOR: A device, usually mounted on the intake manifold of an engine, which mixes the air and fuel in the proper proportion to allow even combustion.

CATALYTIC CONVERTER: A device installed in the exhaust system, like a muffler, that converts harmful byproducts of combustion into carbon dioxide and water vapor by means of a heat-producing chemical reaction.

CENTRIFUGAL ADVANCE: A mechanical method of advancing the spark timing by using flyweights in the distributor that react to centrifugal force generated by the distributor shaft rotation.

CHECK VALVE: Any one-way valve installed to permit the flow of air, fuel or vacuum in one direction only.

GLOSSARY

CHOKE: A device, usually a moveable valve, placed in the intake path of a carburetor to restrict the flow of air.

CIRCUIT: Any unbroken path through which an electrical current can flow. Also used to describe fuel flow in some instances.

CIRCUIT BREAKER: A switch which protects an electrical circuit from overload by opening the circuit when the current flow exceeds a predetermined level. Some circuit breakers must be reset manually, while most reset automatically.

COIL (IGNITION): A transformer in the ignition circuit which steps up the voltage provided to the spark plugs.

COMBINATION MANIFOLD: An assembly which includes both the intake and exhaust manifolds in one casting.

COMBINATION VALVE: A device used in some fuel systems that routes fuel vapors to a charcoal storage canister instead of venting them into the atmosphere. The valve relieves fuel tank pressure and allows fresh air into the tank as the fuel level drops to prevent a vapor lock situation.

COMPRESSION RATIO: The comparison of the total volume of the cylinder and combustion chamber with the piston at BDC and the piston at TDC.

CONDENSER: 1. An electrical device which acts to store an electrical charge, preventing voltage surges.

2. A radiator-like device in the air conditioning system in which refrigerant gas condenses into a liquid, giving off heat.

CONDUCTOR: Any material through which an electrical current can be transmitted easily.

CONTINUITY: Continuous or complete circuit. Can be checked with an ohmmeter.

COUNTERSHAFT: An intermediate shaft which is rotated by a mainshaft and transmits, in turn, that rotation to a working part.

CRANKCASE: The lower part of an engine in which the crankshaft and related parts operate.

CRANKSHAFT: The main driving shaft of an engine which receives reciprocating motion from the pistons and converts it to rotary motion.

CYLINDER: In an engine, the round hole in the engine block in which the piston(s) ride.

CYLINDER BLOCK: The main structural member of an engine in which is found the cylinders, crankshaft and other principal parts.

CYLINDER HEAD: The detachable portion of the engine, fastened, usually, to the top of the cylinder block, containing all or most of the combustion chambers. On overhead valve engines, it contains the valves and their operating parts. On overhead cam engines, it contains the camshaft as well.

DEAD CENTER: The extreme top or bottom of the piston stroke.

DETONATION: An unwanted explosion of the air/fuel mixture in the combustion chamber caused by excess heat and compression, advanced timing, or an overly lean mixture. Also referred to as "ping".

DIAPHRAGM: A thin, flexible wall separating two cavities, such as in a vacuum advance unit.

DIESELING: A condition in which hot spots in the combustion chamber cause the engine to run on after the key is turned off.

DIFFERENTIAL: A geared assembly which allows the transmission of motion between drive axles, giving one axle the ability to turn faster than the other.

DIODE: An electrical device that will allow current to flow in one direction only.

DISC BRAKE: A hydraulic braking assembly consisting of a brake disc, or rotor, mounted on an axle, and a caliper assembly containing, usually two brake pads which are activated by hydraulic pressure. The pads are forced against the sides of the disc, creating friction which slows the vehicle.

DISTRIBUTOR: A mechanically driven device on an engine which is responsible for electrically firing the spark plug at a predetermined point of the piston stroke.

DOWEL PIN: A pin, inserted in mating holes in two different parts allowing those parts to maintain a fixed relationship.

DRUM BRAKE: A braking system which consists of two brake shoes and one or two wheel cylinders, mounted on a fixed backing plate, and a brake drum, mounted on an axle, which revolves around the assembly. Hydraulic action applied to the wheel cylinders forces the shoes outward against the drum, creating friction, slowing the vehicle.

DWELL: The rate, measured in degrees of shaft rotation, at which an electrical circuit cycles on and off.

ELECTRONIC CONTROL UNIT (ECU): Ignition module, module, amplifier or igniter. See Module for definition.

ELECTRONIC IGNITION: A system in which the timing and firing of the spark plugs is controlled by an electronic control unit, usually called a module. These systems have no points or condenser.

ENDPLAY: The measured amount of axial movement in a shaft.

ENGINE: A device that converts heat into mechanical energy.

EXHAUST MANIFOLD: A set of cast passages or pipes which conduct exhaust gases from the engine.

FEELER GAUGE: A blade, usually metal, of precisely predetermined thickness, used to measure the clearance between two parts. These blades usually are available in sets of assorted thicknesses.

F-Head: An engine configuration in which the intake valves are in the cylinder head, while the camshaft and exhaust valves are located in the cylinder block. The camshaft operates the intake valves via lifters and pushrods, while it operates the exhaust valves directly.

FIRING ORDER: The order in which combustion occurs in the cylinders of an engine. Also the order in which spark is distributed to the plugs by the distributor.

FLATHEAD: An engine configuration in which the camshaft and all the valves are located in the cylinder block.

FLOODING: The presence of too much fuel in the intake manifold and combustion chamber which prevents the air/fuel mixture from firing, thereby causing a no-start situation.

FLYWHEEL: A disc shaped part bolted to the rear end of the crankshaft. Around the outer perimeter is affixed the ring gear. The starter drive engages the ring gear, turning the flywheel, which rotates the crankshaft, imparting the initial starting motion to the engine.

FOOT POUND (ft.lb. or sometimes, ft. lbs.): The amount of energy or work needed to raise an item weighing one pound, a distance of one foot.

FUSE: A protective device in a circuit which prevents circuit overload by breaking the circuit when a specific amperage is present. The device is constructed around a strip or wire of a lower amperage rating than the circuit it is designed to protect. When an amperage higher than that stamped on the fuse is present in the circuit, the strip or wire melts, opening the circuit.

GEAR RATIO: The ratio between the number of teeth on meshing gears.

GENERATOR: A device which converts mechanical energy into electrical energy.

HEAT RANGE: The measure of a spark plug's ability to dissipate heat from its firing end. The higher the heat range, the hotter the plug fires.

HUB: The center part of a wheel or gear.

HYDROCARBON (HC): Any chemical compound made up of hydrogen and carbon. A major pollutant formed by the engine as a byproduct of combustion.

HYDROMETER: An instrument used to measure the specific gravity of a solution.

INCH POUND (in.lb. or sometimes, in. lbs.): One twelfth of a foot pound.

INDUCTION: A means of transferring electrical energy in the form of a magnetic field. Principle used in the ignition coil to increase voltage.

INJECTION PUMP: A device, usually mechanically operated, which meters and delivers fuel under pressure to the fuel injector.

INJECTOR: A device which receives metered fuel under relatively low pressure and is activated to inject the fuel into the engine under relatively high pressure at a predetermined time.

INPUT SHAFT: The shaft to which torque is applied, usually carrying the driving gear or gears.

INTAKE MANIFOLD: A casting of passages or pipes used to conduct air or a fuel/air mixture to the cylinders.

JOURNAL: The bearing surface within which a shaft operates.

KEY: A small block usually fitted in a notch between a shaft and a hub to prevent slippage of the two parts.

MANIFOLD: A casting of passages or set of pipes which connect the cylinders to an inlet or outlet source.

MANIFOLD VACUUM: Low pressure in an engine intake manifold formed just below the throttle plates. Manifold vacuum is highest at idle and drops under acceleration.

MASTER CYLINDER: The primary fluid pressurizing device in a hydraulic system. In automotive use, it is found in brake and hydraulic clutch systems and is pedal activated, either directly or, in a power brake system, through the power booster.

MODULE: Electronic control unit, amplifier or igniter of solid state or integrated design which controls the current flow in the ignition primary circuit based on input from the pick-up coil. When the module opens the primary circuit, the high secondary voltage is induced in the coil.

NEEDLE BEARING: A bearing which consists of a number (usually a large number) of long, thin rollers.

OHM: (Ω) The unit used to measure the resistance of conductor to electrical flow. One ohm is the amount of resistance that limits current flow to one ampere in a circuit with one volt of pressure.

OHMMETER: An instrument used for measuring the resistance, in ohms, in an electrical circuit.

OUTPUT SHAFT: The shaft which transmits torque from a device, such as a transmission.

OVERDRIVE: A gear assembly which produces more shaft revolutions than that transmitted to it.

OVERHEAD CAMSHAFT (OHC): An engine configuration in which the camshaft is mounted on top of the cylinder head and operates the valve either directly or by means of rocker arms.

OVERHEAD VALVE (OHV): An engine configuration in which all of the valves are located in the cylinder head and the camshaft is located in the cylinder block. The camshaft operates the valves via lifters and pushrods.

OXIDES OF NITROGEN (NO_x): Chemical compounds of nitrogen produced as a byproduct of combustion. They combine with hydrocarbons to produce smog.

OXYGEN SENSOR: Used with the feedback system to sense the presence of oxygen in the exhaust gas and signal the computer which can reference the voltage signal to an air/fuel ratio.

PINION: The smaller of two meshing gears.

PISTON RING: An open ended ring which fits into a groove on the outer diameter of the piston. Its chief function is to form a seal between the piston and cylinder wall. Most automotive pistons have three rings: two for compression sealing; one for oil sealing.

PRELOAD: A predetermined load placed on a bearing during assembly or by adjustment.

PRIMARY CIRCUIT: Is the low voltage side of the ignition system which consists of the ignition switch, ballast resistor or resistance wire, bypass, coil, electronic control unit and pick-up coil as well as the connecting wires and harnesses.

PRESS FIT: The mating of two parts under pressure, due to the inner diameter of one being smaller than the outer diameter of the other, or vice versa; an interference fit.

GLOSSARY

RACE: The surface on the inner or outer ring of a bearing on which the balls, needles or rollers move.

REGULATOR: A device which maintains the amperage and/or voltage levels of a circuit at predetermined values.

RELAY: A switch which automatically opens and/or closes a circuit.

RESISTANCE: The opposition to the flow of current through a circuit or electrical device, and is measured in ohms. Resistance is equal to the voltage divided by the amperage.

RESISTOR: A device, usually made of wire, which offers a preset amount of resistance in an electrical circuit.

RING GEAR: The name given to a ring-shaped gear attached to a differential case, or affixed to a flywheel or as part a planetary gear set.

ROLLER BEARING: A bearing made up of hardened inner and outer races between which hardened steel rollers move.

ROTOR: 1. The disc-shaped part of a disc brake assembly, upon which the brake pads bear; also called, brake disc.

2. The device mounted atop the distributor shaft, which passes current to the distributor cap tower contacts.

SECONDARY CIRCUIT: The high voltage side of the ignition system, usually above 20,000 volts. The secondary includes the ignition coil, coil wire, distributor cap and rotor, spark plug wires and spark plugs.

SENDING UNIT: A mechanical, electrical, hydraulic or electromagnetic device which transmits information to a gauge.

SENSOR: Any device designed to measure engine operating conditions or ambient pressures and temperatures. Usually electronic in nature and designed to send a voltage signal to an on-board computer, some sensors may operate as a simple on/off switch or they may provide a variable voltage signal (like a potentiometer) as conditions or measured parameters change.

SHIM: Spacers of precise, predetermined thickness used between parts to establish a proper working relationship.

SLAVE CYLINDER: In automotive use, a device in the hydraulic clutch system which is activated by hydraulic force, disengaging the clutch.

SOLENOID: A coil used to produce a magnetic field, the effect of which is produce work.

SPARK PLUG: A device screwed into the combustion chamber of a spark ignition engine. The basic construction is a conductive core inside of a ceramic insulator, mounted in an outer conductive base. An electrical charge from the spark plug wire travels along the conductive core and jumps a preset air gap to a grounding point or points at the end of the conductive base. The resultant spark ignites the fuel/air mixture in the combustion chamber.

SPLINES: Ridges machined or cast onto the outer diameter of

a shaft or inner diameter of a bore to enable parts to mate without rotation.

TACHOMETER: A device used to measure the rotary speed of an engine, shaft, gear, etc., usually in rotations per minute.

THERMOSTAT: A valve, located in the cooling system of an engine, which is closed when cold and opens gradually in response to engine heating, controlling the temperature of the coolant and rate of coolant flow.

TOP DEAD CENTER (TDC): The point at which the piston reaches the top of its travel on the compression stroke.

TORQUE: The twisting force applied to an object.

TORQUE CONVERTER: A turbine used to transmit power from a driving member to a driven member via hydraulic action, providing changes in drive ratio and torque. In automotive use, it links the driveplate at the rear of the engine to the automatic transmission.

TRANSDUCER: A device used to change a force into an electrical signal.

TRANSISTOR: A semi-conductor component which can be actuated by a small voltage to perform an electrical switching function.

TUNE-UP: A regular maintenance function, usually associated with the replacement and adjustment of parts and components in the electrical and fuel systems of a vehicle for the purpose of attaining optimum performance.

TURBOCHARGER: An exhaust driven pump which compresses intake air and forces it into the combustion chambers at higher than atmospheric pressures. The increased air pressure allows more fuel to be burned and results in increased horsepower being produced.

VACUUM ADVANCE: A device which advances the ignition timing in response to increased engine vacuum.

VACUUM GAUGE: An instrument used to measure the presence of vacuum in a chamber.

VALVE: A device which control the pressure, direction of flow or rate of flow of a liquid or gas.

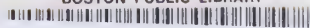
VALVE CLEARANCE: The measured gap between the end of the valve stem and the rocker arm, cam lobe or follower that activates the valve.

VISCOSITY: The rating of a liquid's internal resistance to flow.

VOLTMETER: An instrument used for measuring electrical force in units called volts. Voltmeters are always connected parallel with the circuit being tested.

WHEEL CYLINDER: Found in the automotive drum brake assembly, it is a device, actuated by hydraulic pressure, which, through internal pistons, pushes the brake shoes outward against the drums.

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